Welding Engineer

East Engin.
Library

ONEER BUSINESS AND TECHNICAL JOURNAL OF THE WELDING INDUSTRY

MAY

MAY 13 1942

QUALITY JACKSON PRODUCTS

Unhandy Jobs are no Hazard —not for *this* Holder!

IN THE war industries where the essentials of Victory demand speed—*more speed*—it's necessary to handle difficult jobs faster than usual practice permits. This is particularly true in the production of ships, tanks and other implements of war where arc welding is playing an increasingly important part.

That is why more and more Jackson Streamlined Electrode Holders (made in 300 Amp. F-3 and 500 Amp. F-5) are being put to work. Slim, neatly balanced and easy to manipulate, they quickly reach the spot in difficult, hard-to-get-at places. *Unhandy jobs are no hazard.*

These holders are fully insulated—provide *safety* for the welder. This insulation eliminates accidental flashes and arc breakage caused by contacting the ordinary bare type holder with grounded work. That means less work spoilage—more tanks and ships produced in *much less time.*

Scientifically ventilated, these holders work *cool.* Mechanical cable connection (soldered if you wish) is *dependable.* Deep slotted, quickly replaceable jaw plates of Mallory 3 Metal grip rods securely at *correct angle.* Model F-3, 300 Amps., takes rods to 1/4" and our heavy duty 500 Amp. job, F-5, takes rods to 3/8".

Contact your dealer, get your hands on these Model F holders and you'll understand why they are nothing less than outstanding for handling difficult shipbuilding and war implement jobs at top speed.

Write today for our Holder Folder describing our complete line of insulated and semi-insulated models ranging from 200 to 500 Amps. There's a model for every metallic arc welding job.

JACKSON PRODUCTS

3265 Wight Street, Detroit, Michigan

In Canada: Hollup Corporation, Limited, Toronto.
Paragon Supplies, Limited, Vancouver
Export Distributors: International Technic, Inc., 381 Fourth Avenue, New York City

Vol. XXVII No. 5 May, 1942

The Welding Engineer

ABP ABC MEMBER

Associated Business Papers
Audit Bureau of Circulations
American Welding Society
International Acetylene Association

G. H. MACKENZIE
President and Treasurer

T. B. JEFFERSON
Editor

FRANK RICHTER
Promotion Manager

» «

Eastern Representative:
T. E. DEPEW, 1834 Broadway, New York, N.Y.
Tel. Columbus 5-7843

Midwest Representative:
D. R. WATSON, 506 S. Wabash Ave.
Chicago: Tel. Webster 7134

Pacific Coast Representative:
W. R. McINTYRE, 400 East Third St.
Los Angeles, Tel. Michigan 8918

» «

Published on the 1st of each month by The Welding Engineer Publishing Company, 506 South Wabash Ave., Chicago, Ill.

Telephone Webster 7134

Advertising copy must be received not later than the 20th of the preceding month.

IN THIS ISSUE

COVER: An all-welded bow for a tanker is swung into place. Photo courtesy U. S. Steel Corp.

ARTICLES

Repair Tools by Welding 27
T. B. JEFFERSON

Trailers from a Job Shop 31

Welding Training 34
D. E. ROBERTS

X-Ray Examination of Welds 39
R. T. FOREMAN

Production Spot Welding 42
B. J. TODDSWORTH

Hardness vs. Wear 45
J. C. MENZIES

Arc Welding Future 50

Advertisers in This Issue 8

What's Here 15

Editorial 25

Brief Sketches of Welding Jobs 52

New Product Developments 54

Engineering Data Sheet No. 20 57

News of the Industry 60

Personals 60

Obituary 63

Current Reviews 68

Recent Patents 74

Classified 81

(Copyrighted 1942)

Subscription, payable in advance: United States and possessions, and Canada, $3 a year; Foreign Countries, $4 a year; Single copy, domestic, 35 cents; Single copy, foreign, 35 cents. Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

FOREIGN REPRESENTATIVES: AUSTRALIA and NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand; BRAZIL—Alpha Jewel Caixa Postal No. 2411, Rio de Janeiro, Brazil; GREAT BRITAIN—A. D. Bayne, 1 Cambridge Park Court, Twickenham, Middlesex, England; SOUTH AFRICA—J. W. Arnison, 35a Victoria Avenue, Benoni Transvaal, South Africa; U. S. S. R.—Mesdunarodnaja Kniga-Kusnezki Most 18, Moscow, U. S. S. R.

REGO
Aircraft Welding Torch

ENGINEERED TO HELP SPEED-UP AIRCRAFT . . . SHEET METAL . . . TUBE . . . AND PRODUCTION WELDING

Write for Descriptive Circular

REGO . . . pioneer equipment for using and controlling high pressure gases . . . distributed by

NATIONAL CYLINDER GAS COMPANY

205 W. Wacker Drive — Chicago, Illinois

Offices in Principal Cities

The Welding Engineer

AMERICA'S PIONEER WELDING JOURNAL

MAY 1942

Established 1916

The Normandie Fires

The Normandie continues to burn! Since February 9 four or more fires have occurred on this huge ocean liner to delay its availability for war service!

These fires are undoubtedly a source of great satisfaction to our enemies, their agents and saboteurs. But why shouldn't the enemy be happy; are not the employees of the Navy Department and its contractors doing the work of their saboteurs?

Not sabotage by intent but sabotage by ignorance and carelessness.

In typical "buck-passing" fashion an attempt has been made to blame the gas cutting torch for the destruction of this $60,000,000 liner. As the news of the fire comes to the public, we read, "Weldor's torch used in cutting metal starts fire."

A cutting torch is designed to cut through metal and in some cases affords the only practical means of severing thick sections. Without the cutting torch our present ship building program of 23,000,000 tons of ships by 1943 would be impossible.

The widespread use of the cutting torch in shipyards without fires proves that it is not a hazardous tool. Any open flame, even the sparks from a cigarette, present a potential fire hazard; consequently, safety precautions should be observed.

At a time when ships are at a premium it would seem that, at least, the same precautions would be observed in making ship repairs that are practical in ship construction!

If you are in doubt as to the safest way to use your welding equipment consult: (1) your welding equipment manufacturer (2) your insurance company; (3) your local fire department; or (4) the National Safety Council.

Don't let carelessness and ignorance defeat your country.

H. B. Jefferson

Here's a 48 to 60 hour week —by working 40 hours!

Everybody says our greatest shortage in the war program is TIME. Here's how to get the welding output of 48 to 60 hours with no more effort and no more time than 40 hours.

ALTER EGO: And how simple! Just select the proper electrode, use the new "Fleet-Fillet" Technique, boost the current—then speed like blazes!

Speed is right! At 50% operating factor, I used to make 15 feet per hour on these 3/8" fillets. Now, with this new "Fleet-Fillet" Technique, I'm getting 30 feet per hour. Twice as fast!

ALTER EGO: And look at the weld metal you save! All in all, the boss says this new technique has cut welding costs more than 50%.

That's why every welder, supervisor, engineer and executive in metal-working industries should air mail a letter to The Lincoln Electric Company, Cleveland, Ohio, for their book on the new "Fleet-Fillet" Technique so that they can put this time saver to work for Uncle Sam at once.

Free copy "Fleet-Fillet" Bulletin No. 432 on request.

THE LINCOLN ELECTRIC COMPANY
CLEVELAND, OHIO

ALTER EGO: Literally, "one's other self"—the still, small voice that questions, inspires and corrects our conscious action.

A welder repairs a broken die by atomic hydrogen welding.

Repair Tools By Welding

Atomic Hydrogen welding offers an excellent means for the repair and maintenance of tools, dies and molds; especially when conservation is so important.

By **T. B. JEFFERSON, M.E.**
Editor

Have you ever been in a plant where everything was at a standstill because of a broken tool? Right when we want to be all out for war, too! Well, it is a sorry and unnecessary sight but it is the reason for the following article.

THE EDITOR.

MATERIALS, particularly the alloy materials used in tool making, are hard to get; also, tools are hard to get. Like tires, tools must be conserved or an expensive, badly needed machine will be left literally "sitting on blocks." The worst of the whole situation, however, is that production is reduced and soldiers are "on the blocks" and empty handed, too.

Naturally, tool breakage and wear cannot be avoided altogether. Many cases of breakage, however, are due to carelessness, so with proper care breakage will be reduced. Nevertheless, proper care will not overcome fatigue breakage, wear or, in some cases, machining mistakes in the making of new tools. Then, too, engineering and design changes sometimes make good tools obsolete.

Salvage Is Vital

Tools which are worn, broken, incorrect or obsolete can be salvaged! Their salvage aids the war effort in many ways, the outstanding of which are: (1) Saving scarce alloys; (2) saving time; (3) providing labor for more vital needs and (4) reducing tool maintenance cost. The facts of these statements are being proved daily by many manufacturers who are using atomic hydrogen welding for repairing, changing or rectifying mistakes in tools, forming dies, forging dies, die casting dies, permanent molds and similar equipment.

Atomic hydrogn welding, one of the newest fusion welding processes, combines the advantages of easy manipulation and accurate control of penetration with the inexpensive heat characteristic of arc welding. In addition there are two particularly valuable properties. These are the reducing properties of the hydrogen flame in the welding zone and the extremely high rate of heat transfer or surface heating available with the atomic hydrogen flame.

In the repair of dies the widest application of atomic hydrogen welding is found in making surface welds such as those used in building up worn dies, molds and similar tools. Here the extremely high rate of surface heating is valuable in that a quick weld may be obtained with a minimum of distortion while the reducing envelope of the atomic hydrogen gas prevents oxidation of the weld surface. This condition provides for an extremely sound dense deposit of weld metal which is extremely important for this type of work.

The process has demonstrated its ability to make tremendous savings because of the ease and speed with which worn parts may be rebuilt and likewise the ease with which filler

Fig. 1—(Upper) Three milling broken cutters which normally would be discarded are successfully repaired by atomic hydrogen welding (lower).

metal can be obtained. Filler metal can frequently be obtained from scraps of the base material or possibly cut from the work piece itself. This is a particularly attractive feature of the process in that practically any of the commonly used base metals can be welded. On the other hand, because of the ease of obtaining filler metal, it is ideal for repairing special ferrous alloys such as chrome, nickel and molybdenum steels as well as the non-ferrous alloys. When it is necessary to obtain a filler rod by cutting it from a piece of a bar or a die it is best to use a band saw. Care should be taken to obtain clean metal, i.e., avoiding the outside of the bar. This prevents any decarburized surface steel from getting into the weld.

Tool Repairs

Our defense industries in some cases have been handicapped because of tool breakage. The most common breaks are those at the cutting edge, consequently the repair of such a break is possible only by a fusion welding process. In Fig. 1 there are shown several different milling cutters before and after repair and after remachining. Naturally, in repair of such high speed tools, if they are to be welded, their alloy components must be completely protected against harmful absorption of oxygen; their composition after welding must remain the same if their original high cutting ability is not to be diminished. These cutters, which were made of a tool steel containing approximately 22% tungsten, were welded using the atomic hydrogen process. A filler rod of the same material as the base metal was used.

Repair Procedure

Prior to welding, the cutters were annealed in order to prevent further breakage as the result of stresses incurred by the concentration of welding heat. Annealing may be accomplished by heating to approximately 1300 F. The welding operation was carried on while the cutter was held at a red hot preheat. After welding the cutters were stress relieved, again the temperature was approximately 1300 F., to eliminate any stresses that might have been set up at the point of welding. The method of annealing is immaterial, the cutters may be annealed directly in a furnace or in a carburizing pack.

In all cases the welded parts should be cooled slowly and evenly so that new stresses will not be created by irregular cooling. It is also imperative that the tool parts remain in a machineable condition so that a new cutting edge can be established.

When the part has cooled off completely the welded portion is then ground or, if necessary, the entire tool is refinished. Refinishing is usually always necessary when the tool has been warped during welding inasmuch as the warpage cannot be entirely eliminated by straightening.

Heat Treatment

After having refinished the cutters they should be hardened just as if they were new, unwelded tools. Since the high alloy steels tend to surface decarburize at high temperatures it is important that the hardening process be carried out in a decarburizing furnace or salt bath. A certain addition of carbon may be desirable in order to compensate for possible loss of carbon during heating.

Actual working tests indicate that cutters repaired in this manner and subjected to proper heat treatment are equivalent to new cutters so far as cutting characteristics are concerned.

Repairs need not be confined to building up points or chipped teeth (Fig. 2) of milling cutters. In Fig. 3 there is shown a double disc milling cuttter which has been broken into several parts. In this case the welding technique is somewhat different than that of rebuilding a tooth point. The fractured edges must fit as accurately as possible so they are beveled to form a "V" prior to welding. The edges are then tack welded to hold them in position after which the welding is undertaken while the parts previously preheated are held at a red heat.

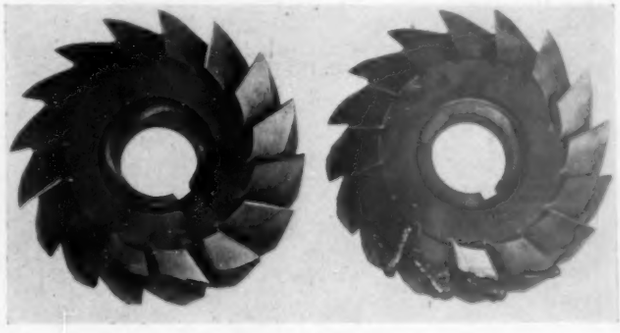


Fig. 2—When teeth are clipped (left) from a milling cutter they are easily rebuilt (right).

Sound Welds Required

In a weld of this type a great deal of care should be exercised to determine that a good, sound continuous connection is obtained. This is particularly important in the vicinity of the teeth and the tack welds. In Fig. 3, at the left, is seen the rear view of a pair of broken interlocking side mills which have been prepared for welding. In the center, the rear view is shown again following welding and annealing; on the right, the front view is shown after having been ground and hardened. These

milling cutters are now ready for use.

While particular reference has been made to milling cutters in the aforementioned welding and heating treating procedure, the methods outlined are equally suited for use in the repair of all high alloy steel tools.

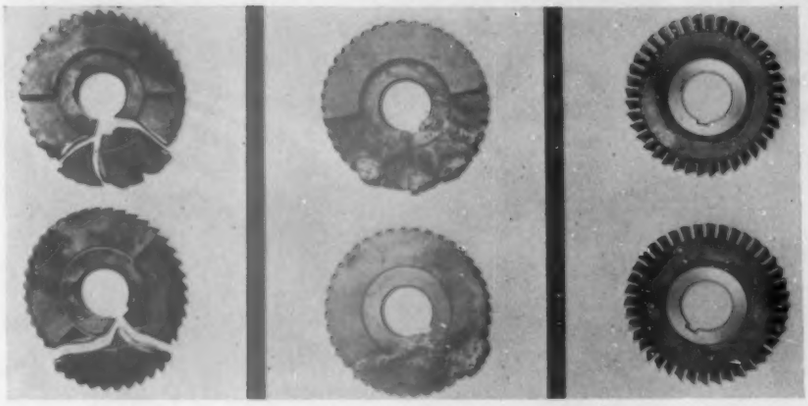


Fig. 3—Even broken double disc mills (left) can be repaired (center) and then be remachined to a like-new condition.

Broach Repairs

In a similar manner it is possible to repair broken broaches with the atomic hydrogen process as is shown in Fig. 4. The repairing of broaches is probably one of the most difficult of tool repair jobs to be undertaken. More difficult than the welding work itself is the straightening of the part after welding has been completed. In the repair of broaches it is absolutely necessary that the accuracy of their original dimensions be maintained if the broaches are to retain their useful value.

Broach repairs are not limited because of size. Frequently repairs are made of high speed steel broaches for broaching holes in steel as small as $\frac{3}{16}$ in. square. In the repair of such small broaches $\frac{1}{8}$ in. dia. straight carbon steel drill rod is often used as a welding rod. If proper care is taken it is frequently possible to complete these repairs without the necessity of re-hardening.

Mold Repairs

An important job for atomic hydrogen welding is the maintenance of plastic and die-casting molds (Fig. 5). These molds in many cases, are short lived because they become marred or scratched when the operator uses an ejecting tool to remove the cast pieces. As soon as they become damaged they are unfit for further service because die-castings or plastics seldom receive further finishing; naturally any imperfection in the die will appear on the casting. Molding dies are difficult to repair because they are made of chrome-nickel alloys to withstand the heat and pressure of either die-casting or plastic molding.

Chrome-Nickel Welds

Chrome-nickel steels at their best are difficult to weld but in the case of molds it is even more difficult because the finished weld must be one that will polish to a high gloss since small irregularities, tiny blow holes or even grinding scratches, will reproduce on the molded product. The welding rod is another problem present in mold repair. A slight variation between the physical or hardness characteristics of the mold and the deposited weld metal might lead to the development of flaws in the finish of the molded product. It can readily be seen that differences in the hardness of the material leads to a different degree of deformation of the mold. Consequently, there will be deviations in the dimensions of the molded parts which, though they may be very little, are nevertheless visible on the surface of the finished product.

Since these molds easily become unsuited for further use it is highly desirable to have a method of repairing them where it is possible to add just a spot of molten metal on the damaged section. By playing an atomic hydrogen flame over the deposited metal it is possible to work the deposit to a smooth feather edge leaving very little excess metal for the toolmaker to machine away. Since there is also an absence of spatter or scale on the finished part of the mold adjacent to the weld, the work of the toolmaker is lessened even further.

Repair of pressure molds is another example of the use of atomic hydrogen. In the repair of this type equipment the manner of preparing for welding, welding and finishing is similar to the procedure previously described in repairing milling cutters. The procedure differs only to the extent that pressure molds are made from less highly alloyed steels and consequently less brittle material than hardened tool steels. This fact makes it possible to do the welding without preheating, annealing or post welding heat treating.

Possible Savings

The practicability of atomic hydrogen for applications other than the repair of molds was recently demonstrated when a Midwest manufacturer was confronted with the necessity of either building two new dies to conform with an improved product design or revamping his existing dies. In this instance new dies

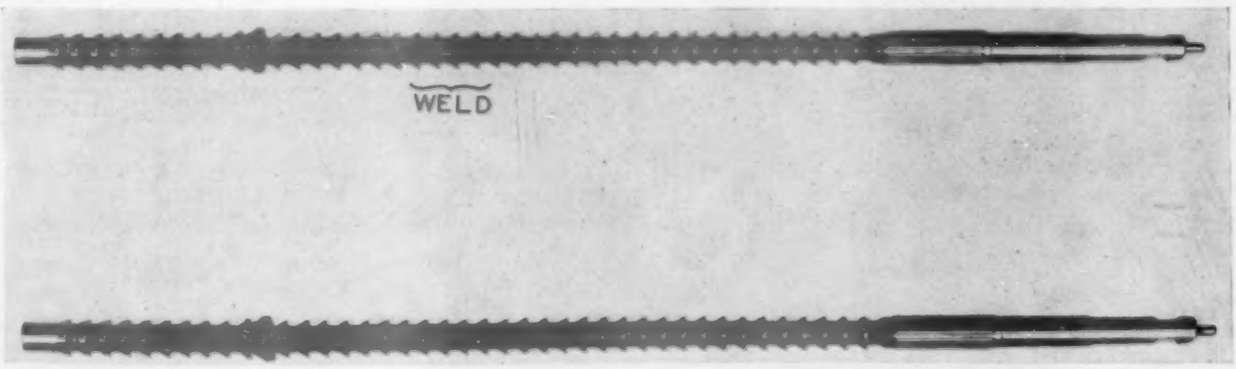


Fig. 4—The straightening of small broaches is often more difficult than the welding.

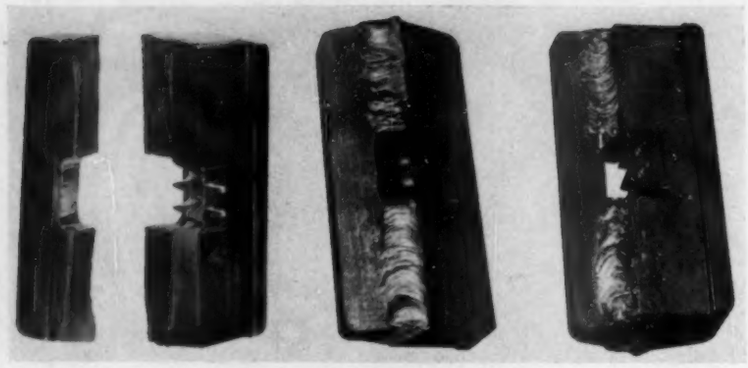


Fig. 5—Atomic hydrogen welding is an important means of maintaining plastic and die-casting molds.

would cost $2800.00 and would require 8 weeks to build, so it was decided to save time and expense by rebuilding the old dies. The dies were completely rebuilt in three weeks at a cost of only $400.00 thus saving the manufacturer $2400.00 on this job.

The cost of rebuilding included annealing the dies for welding; the welding operation; machining; normalizing, to remove stains; recarburizing, to harden the metal; and polishing. This manufacturer points out the advantages of using atomic hydrogen welding for this type of work; the metal added to the dies was of the same carbon content and chemical analysis as the die material and the shielding action of the hydrogen atmosphere prevented the formation of impurities during the welding operation. The built-up area showed the same grain structure and hardness as the remainder of the die.

Die Repairs

Examples of die repair by a New England manufacturer using atomic hydrogen welding are shown in Figs. 6 and 7. In Fig. 6 the die was made of oil hardened tool steel used for punching small parts required in the building of business machines. The chemical composition of this material was .90 carbon; 1.60 manganese; .25 vanadium. Repairs were made by atomic hydrogen welding using an oil hardening drill rod $\frac{5}{32}$ in. in dia. as a welding rod. On this application a 40 amp. welding current was used. Smaller punch dies are welded in the same manner except that the current is varied from 15 to 30 amps., depending upon the size of the weld.

In Fig. 7 there is shown the progressive steps involved in repairing a broken die made from air hardening steel having a chemical composition of .95 carbon, manganese 2.04, 1.93 chromium and 1.04 molybdenum. In this case a steel of the same analysis as the die was used as a welding rod. If a suitable welding rod cannot be obtained otherwise, pieces may be cut from the die and welded together to form a rod.

These are just a few examples citing the use of welding, particularly atomic hydrogen welding, as it is being employed to conserve material and maintain equipment at the highest possible production rate during these times when high production is needed. There are many other examples of work in which this welding process can be used advantageously. It can be used to repair circular saws, high grade machine tools and for other tool welding jobs of this nature.

Welding Precautions

In the repair of tools and dies, however, there are a few points which must be remembered. To prevent the cracking of straight carbon steel, air hardening or oil hardening steel, the pieces to be welded should be carefully annealed before and after welding. This does not always hold true for in some cases it is possible to weld without annealing. However, if there was any doubt it is best to be on the safe side and anneal a piece before it is to be welded. In some welding operations there are slight distortions. These pieces can nearly always be straightened by using pressure while the part is at a red heat. If straightening is not possible sufficient metal should be deposited so that the repaired part can be remachined to the proper size. Tools which have been repaired should be hardened in the same manner as is recommended for tools of the same type that have not been welded.

While operating costs of the atomic hydrogen welding process are not quite as low as those of the conventional arc welding process, nevertheless it is found that atomic hydrogen welding handles work which cannot be done so successfully by other means. Thus, it affords additional opportunities to save time, money, and material in the repair and maintenance of equipment. This is particularly true in the repairs of tools and dies.

The photos on pages 27 and 30 were obtained thru the courtesy of the General Electric Co.

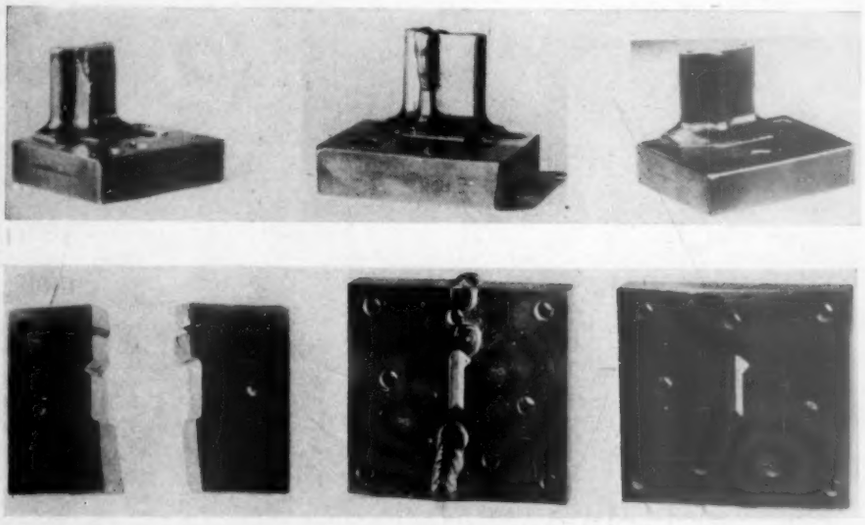


Fig. 6 (Upper) and Fig. 7 (Lower)—Punch press dies, though chipped and broken, are now welded and remachined for further service.

Buy

War Bonds

to Fight

The Axis Bums

Fig. 1—Claude Carlisle of the Carlisle Machine Works, Longview, Tex., stands beside one of the welded bottom-dump trailers which he produces.

Trailers from a Job Shop

Another job shop has converted its operations into those of a successful manufacturing plant. In six years an idea aided by arc welding and flame cutting has become a thriving business.

ALL THAT IS needed to start a lucrative manufacturing business, it would appear from the experience of a Texas weldor, is an idea and some good arc welding equipment. Claude Carlisle, owner of the Carlisle Machine Works, Long View, Texas, started his welding career as a maintenance weldor on the Santa Fe Railroad. He has been in Long View since the late 1920's, doing job welding of all kinds.

Carlisle became interested in the construction of bottom dump trailers and during the past six years has developed a good business building and selling trailers such as the one shown in Fig. 1.

These trailers have a capacity of from 5 to 10 yards and are used extensively throughout the Southwest, notably in airport construction, flood control work, road construction and more recently on defense construction.

A 6 cu. yd. trailer, 18 ft. long, is shown in Fig. 1. The side members of the frame are 8 in. channels reinforced with ½ in. plate welded on the webs. The hoppers are welded from 10 ga. plate and are reinforced with 3 in. "T" sections. The dump doors are of ¼ in. plate reinforced with angle and bar scrap. Most of the welding is done with $\frac{3}{16}$ in. electrodes.

All-Welded Axle

During his six years as a manufacturer of dump trailers, Carlisle has found that the application of welding and cutting solves most of the problems encountered. For example, axles such as that shown in Fig. 2 (lower) frequently broke under the rough service conditions they received in the field. An axle of this type could not be used on trailers having a capacity greater than 5 cu. yds. To overcome this difficulty Carlisle devised the all-welded axles shown in Fig. 2 (upper). This axle is suitable for 10 cu. yd. trailers and cost no more than the former cast axles. Not a single welded axle has ever failed in service.

The axle is of highly conservative design, incorporating a box section of ½ in. plate and welded throughout. The plates on the ends are of ¾ in. material. The axles themselves are of 4 in. seamless tubing having ½ in. walls. These are welded into the ends of the box section prior to its assembly with the rest of the axle. All joints in the box section are beveled.

The axle assembly is reinforced with a truss made from 4 by ⅜ in. bar as shown. After welding the axles are machined for a ¼ in. cambre to enable the trailer wheels to ride perpendicular to the curvature of the average roads. The total cutting and welding time for each axle is 5½ hrs.

A rear end of a Carlisle bottom-dump trailer is shown in Fig. 3. The rugged welded steel construction of the frame and bumper may be seen.

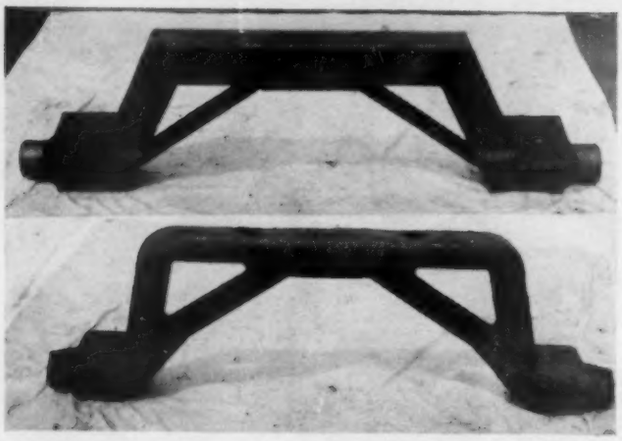


Fig. 2 — (Upper) The all-welded axle is much stronger than its cast predecessor (lower).

Fig. 3—A rear view of a trailer with an all-welded axle in place.

Fig. 4—Welded die and a completed welded sheave used on these trailers.

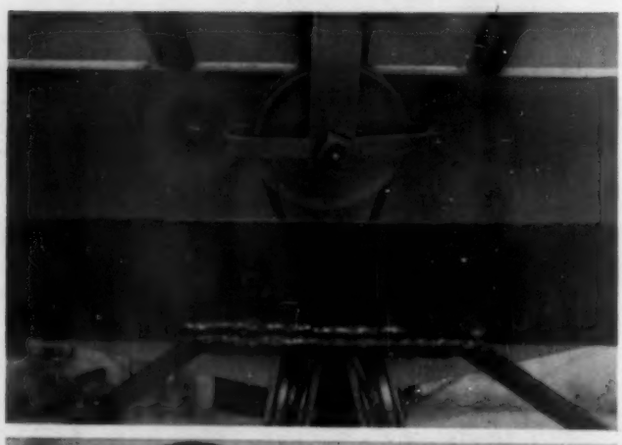


Fig. 5—An equalizer sheave installed on a trailer.

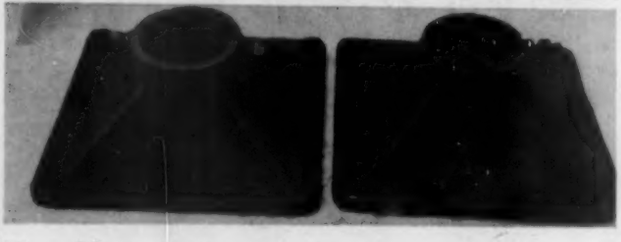


Fig. 6—These kingpin bases show another conversion to all-welded design. The welded base on the right is stronger and less expensive.

This also shows one of the all-welded axles installed on the frame. Not only are the major parts of the trailers all-welded. A majority of the small parts are fabricated also by welding.

Equalizer Sheaves

Equalizer sheaves as shown in Fig. 4 are made from 2–$\frac{3}{16}$ in. thick flame cut discs. These discs, which are 8 in. in dia., are then drilled in the center to take a ¾ in. pipe. After which they are heated and placed in the welded dies shown in Fig. 4 (left), and dished under a trip hammer. The die shown at the right is the male member used in this forming operation. After being shaped the formed plates are placed with the concave sides outward and a ¾ in. pipe is welded through the center. Several beads of weld metal are now laid in the groove between the two plates after which the assembly is placed in a lathe and turned to provide a smooth concentric groove and rim.

The completed equalizer sheave, installed on one of the trailers, is shown in Fig. 5.

King Pin Bases

The kingpin bases shown in Fig. 6 illustrate again how money can be saved by welding pieces such as this. The previous construction on the left cost $4.15 in the rough. The welded construction, shown on the right, a stronger piece, was fabricated for $3.10. The welded base is made from one piece of ½ in. plate, 12 in. square, with a 5 in. length of 5 in. pipe welded in the center and stiffened by triangular gussets cut from ⅜ in. plate and welded to the plate and pipe as shown. Nuts were welded on both sides of the pipe to provide a threaded connection for set screws.

Drum Shaft Bearings

In fabricating drum shaft bearings by welding, the fixture shown in Fig. 7 (upper) is used. It was made from scrap angle iron threaded for bolts to clamp the component parts in place. The bearings consist of a base of 3 in. extra heavy pipe and two pieces of 2 by ½ in. bar beveled and butt welded to the pipe as shown. Such a bearing is shown in front of the fixture.

A comparison of the type of drum shaft bearing previously used and the present welded type is seen in Fig. 7 (lower). The former bearing, shown at the left, cost $1.05 in the rough.

The welded bearing, right, was made for only 50 cents.

Friction Wheels

Friction wheels which are driven by the trailer's tires are shown in Fig. 8. These wheels, by means of a chain drive, work the door closing drum. The wheel shown on the left is the former cast iron construction and that on the right is the new welded fabrication. The rim of the friction wheel is cut from 10 in. pipe. The web is flame cut from ¼ in. plate while a 2 in. pipe is used for the hub and the sprocket is a small steel bearing. The ribs on the rim are ⅜ in. round bars welded to the rim as shown. The welded wheel is built at a saving of 20% over the former construction.

Flame Cut Pawls

In Fig. 10 is shown another small part which is welded with a saving in time and money. The pawl and box on the left are of the type formerly used. A new pawl and box of welded design are shown at the right. The cost of these two pieces of cast construction, before machining, was $1.55. The welded assembly shown at the right is made complete for $1.10.

The method of fabricating the all-welded pawl unit is quite simple. The pawl is made from a piece of 2 in. round shaft and a piece of 2 x ¾ in. steel bar. These two pieces are flame cut to the shapes shown. The box sides are made from a 2 x ⅜ in. steel bar with a 2 x ¾ in. bar for the center spacer. Practically all of this material is scrap. The parts are held firmly in the jig shown in Fig. 10 (center) and are welded to make finished pawl on the right.

This Texas job shop has demonstrated how ingenuity combined with arc welding and flame cutting have changed a job shop into a major manufacturing enterprise. As this job shop has been able to convert its operation to meet the demands of industry, many job shops throughout the country will be able to convert their efforts to meet the demands of our war program.

This is the second in *The Welding Engineer's* series of articles on successful job shop operation; there will be more to follow. The photos for the illustrations used in this article were furnished by the Lincoln Electric Co.

» «

Buy War Bonds

» «

Fig. 7 (Upper)—Fixture used to fabricate, by means of the electric arc, welded drum shaft bearings. A completed bearing is shown in front of the jig (lower).

The old and the new. The bearing at the right is of welded construction and costs less than half as much as the former type (left).

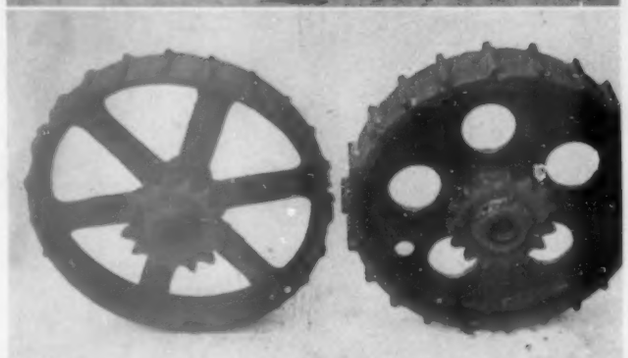


Fig. 8—The welded friction wheel at the right saves 20% over the previous design and is a stronger wheel.

Fig. 9—The pawl and box assembly in use on the trailer.

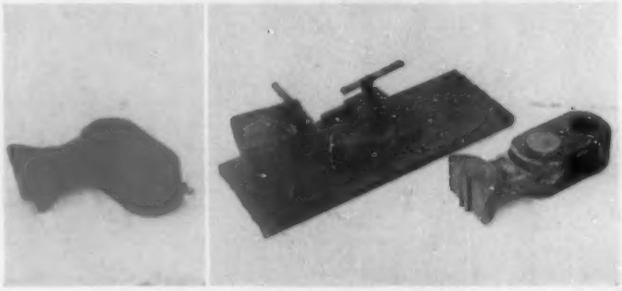


Fig. 11—Both the pawl and the box on the right in this picture are of welded construction. The former pawl and box are at the left, while the jig for holding the pawl during welding is in the center.

War production demands make it necessary to train welders and cutting torch operators.

Photo Cleveland School of Welding

Training Oxy-Acetylene Welding and Cutting Operators

D. E. ROBERTS
International Acetylene Association

Welding schools and training methods are discussed. There is outlined: Basic objectives; type of school; school organization and teaching methods to meet our war needs.

THE INCREASING need for large numbers of skilled workers and the consequent heavy demand upon training facilities, factors recently brought into the focus of public attention by the National Defense Program, are not new to the welding and cutting industry. This industry has grown so rapidly, and the utility of the welding and cutting processes to the metal-working industry has been proved to be so great, that the importance of operator training has long been recognized. The American Welding Society, the International Acetylene Association, the welding and cutting equipment and supplies manufacturers, and other groups have presented a great deal of material over the years for the training of welding operators.

Development of such teaching material by these organizations naturally can never be said to be complete, but rather is a continuing endeavor keeping pace with the new developments in the industry and with the progress in vocational educational education techniques. It is the purpose of this article to summarize the important factors to be taken into consideration when planning the training of operators, and to describe briefly a new and timely publication of the International Acetylene Association that is available as an aid in such planning.

*Presented at the Twenty-Second Annual Meeting of the American Welding Society, Philadelphia, Pa., October 20-24, 1941.

Basic Objective

The problems involved in the training of operators for either welding or cutting are influenced by a number of definite factors. The most important of these factors are:

A. The basic objective to be attained.

B. Type of school organization to accomplish the training.

C. Physical and business organization of the school.

D. Type of course and teaching method.

During any period of rapidly increased industrial activity, many persons normally engaged in other lines of endeavor, must devote considerable attention to education. In the chart in Fig. 1, the factors entering into the training of operators have been grouped in their proper relationship, and a study of this chart will reveal that its primary purpose is to direct the thinking of a person faced with the problem of training welding or cutting operators.

Broadly speaking, welding operators as a group can be broken down into three different types, depending upon the work they do or are qualified to do.

One-Type Weld

There are a number of examples of operators who would fit into this classification, but in the main all

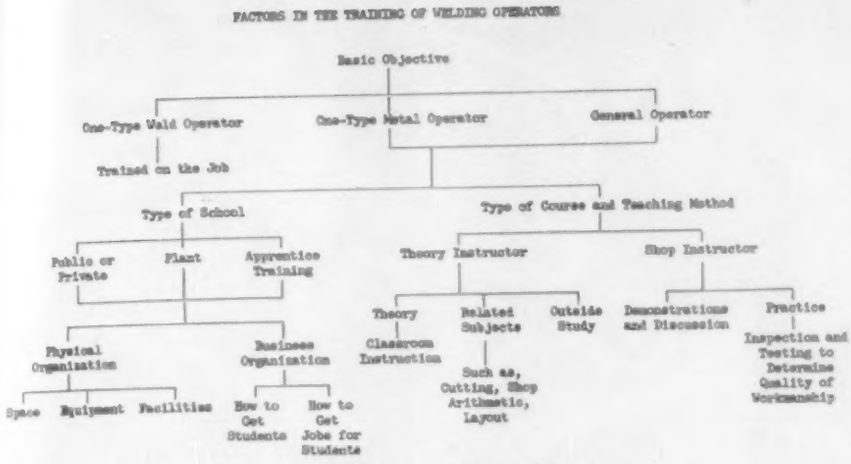


Fig. 1—Factors in the training of welders.

are engaged in mass production work. To a large extent such operators are trained on the job and the training is devoted solely to making them capable of welding one joint, or at most one type of joint. Undoubtedly from the standpoint of immediate industrial efficiency, such a system of training is satisfactory, but this obviously presents no opportunity to give consideration to the future of the operator, from either his own, the industrial, or the social viewpoint.

Although such an operator is usually referred to as a "welder," the limited training and experience that is required to make him able to perform his task satisfactorily places a discussion of his training outside the scope of this paper.

One-Type Metal

A large proportion of the oxy-acetylene welding operators fit into this classification. Aircraft welding operators are an example of a "one-type metal" operator. Although a number of different metals used in aircraft construction are welded, most aircraft welding operators work only on one type of base metal, such as on steel, aluminum, stainless steel, or Inconel. Of course, each qualified man is capable of welding any type of structure that is to be constructed from the base metal in which he specializes. There are a number of other examples of this type of operator that might be mentioned, such as copper vessel fabricators, sheet steel welding operators, and pipe welding operators.

Welding Shop, or Maintenance and Repair Operator

"General welding operator" is the name that is usually given to this type, because he is expected to be able to weld a wide variety of articles made of practically any metal or alloy. The requirements of his occupation make it obvious that such a man must have a good general fundamental training supplemented by considerable practical experience. Usually such a man will also be found to be a good all-round mechanic.

Types of Schools

There are three basic types of schools in use for the training of welding and cutting operators, and the choice of school depends largely upon the facilities available and the type of operator to be trained.

Public or Private Schools

Public or private schools include those that teach welding only and those that teach a variety of vocational and allied subjects, including welding. There are times when the general vocational school is preferred for welding training because the school is often organized better for educational purposes, due to the experience of those in charge and the possibility of greater specialization by the instructors. On the other hand, the school that teaches welding only devotes all of its attention to that particular subject, and this concentrated "atmosphere" is frequently conducive to better results.

The schools having courses in other vocational subjects than welding may be those giving instruction in a trade in which welding is a tool, or they may be general vocational schools. An example of the former would be a school teaching the steamfitter's trade, in which welding is one subject of the course. Such schools of course are usually well qualified to give the type of welding training of most value to the student. The general vocational school, on the other hand, gives courses in a considerable number of unrelated subjects. In such schools, as a rule, the science of vocational education is highly developed and the time of the student, as well as of the instructor, is usually efficiently employed. Such schools can frequently offer better courses in such related subjects as blueprint reading, shop arithmetic and layout work than can the straight welding school.

There is little to choose between public and private schools or between the various types of schools in this group purely on the basis of type. Naturally, it is the quality of the men being turned out by the school that is the only reliable criterion of its excellence.

Any public or private school teaching welding should do everything possible to work in close co-operation with local industry, in order that efforts may be made to train the type of operator most in demand and to give the type of training that the local industry expects. This not only makes it easier for the school to place its graduates, but also makes it possible for the school's instructors to give economically sound and technically accurate advice to the students.

An important policy of all good private welding schools is an arrangement whereby students who show no aptitude for the subject after a reasonable trial are persuaded to discontinue the course. Under these circumstances, of course, at least most of the tuition fee should

Well lighted and ventilated school rooms are desired for training purposes.

New England Welding Laboratories, Inc. Photo

be returned to the student in accordance with some agreement made at the time the student enrolls. Of course, the public schools are restricted considerably on this point, and it therefore requires considerable thought and tact on the part of public school authorities to make it possible for them to recommend to industry all the graduates of their courses.

Plant Schools

The plant school is run very much like the public or private school, but has the advantage that this school does not need to make a profit and may even operate at a loss. This puts the student more on his own mettle to remain in the course. Plant schools can operate co-operatively with public or private schools to give basic training, while advanced students can work as helpers in the plant to get valuable advance training, using all spare time to get organized practice in fundamental techniques. Usually the students in plant schools pursue courses in related subjects or in theory either at home or in organized classes at public or private schools.

There is always a considerable difference between a school and industry—no matter how much effort is made to operate the school like a shop. Therefore, the graduate of a public or private school must always go through a transition period, during which he becomes accustomed to shop practices and policies. This factor gives the plant school certain advantages over the public and private schools, in that the operator can be trained specifically for work in that particular plant and can receive basic training in plant policy during his primary training at the school.

Apprentice Training Program

The apprentice training program is an old and familiar method for giving vocational instruction. Naturally, because of cost, it requires a rather large industrial organization using considerable numbers of workmen to warrant the inauguration of such a program. Frequently apprentice training programs are developed primarily to train foremen or other supervisory personnel.

It is probably true that the apprentice program gives the best training to workmen, mainly because a considerably longer time is devoted to their training. It is important in an apprentice program, however, that the classroom work be presented with as much consideration for the psychology of education as is done in public or private schools.

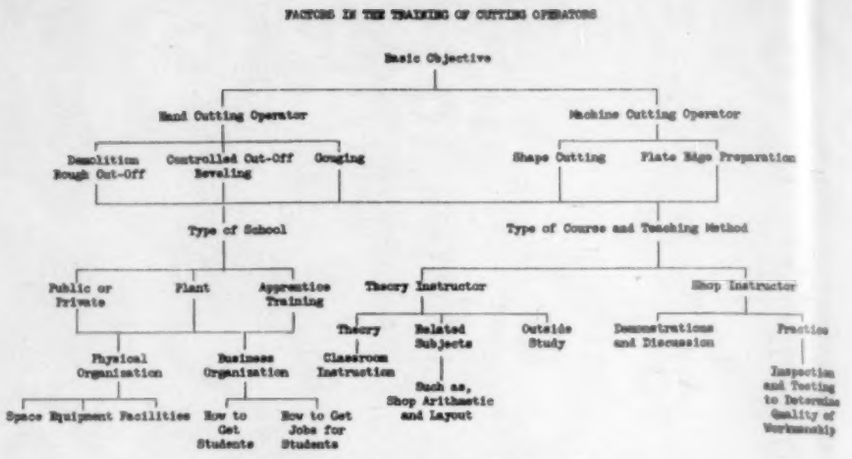


Fig. 2—Factors in the training of cutting operators.

The apprentice course, like the plant school, has the advantage of smoothing out the transition period of the student between the school and the plant and offers the opportunity of considerable practice under actual production conditions. In many apprentice programs, the student remains under the supervision of the school for a considerable period of time after he goes to work in the plant so that his full potentialities can be developed.

Physical and Business Organization

Under the subject of physical and business organization of the school such factors as the physical arrangement of the school, including space, equipment, and other facilities; and the methods to be pursued in getting students and obtaining jobs for them upon the completion of their courses should be considered.

Physical Organization

It is somewhat beyond the scope of this paper to discuss the details of physical organization of a school, but a few of the factors which should be given consideration will be mentioned.

Space. In addition to providing sufficient room to avoid congestion and confusion, such important items as adequate lighting, adequate ventilation, and fire prevention should be considered under the subject of space.

Equipment. It is preferable that the equipment be adequate so that all students in a class can be accommodated at the same time. In addition to the actual welding or cutting equipment, machines for preparing specimens for welding and for testing should be included.

Facilities. Locker rooms, toilet facilities, and washrooms should be supplied. Available welding and cutting literature should be kept in a library so that it can be loaned to the students for outside study.

Business Organization

Naturally, a private school must make a profit. Like any business, this requires careful cost analysis and control. In the same manner that any business may make a profit for a time even though turning out poor quality products, particularly during a boom period, the welding school must turn out qualified students in order to be a continued success. Even more than many types of business, the welding school depends upon repeat orders for success.

Training of Cutting Operators

Before discussing the type of course and teaching method, it would be well to bring out one or two points regarding the training of cutting operators.

The important factors to be considered in the planning for the training of cutting operators are given in Fig. 2. It will be noticed that, aside from the types of operators to be trained, these items parallel closely those given in Fig. 1 for training welding operators.

Until recently, practically all cutting operators were trained by industry in plant schools or apprentice programs. It is not difficult to see why this has been and one contributing reason will probably suffice as an explanation. The demand from industry for operators already basically trained to perform cutting has been loudly voiced only recently. The immediate result of this demand, however, has been that private schools for the training of cutting operators have now been formed and more such schools can be expected.

Type of Course and Teaching Method

No matter how plenteous and good the apparatus nor how ample and well arranged the space, the ultimate success of a welding or cutting course depends fundamentally upon the in-

Cutting torch operation is an essential part of a training course.

Chicago N.Y.A. Photo

struction given. Anyone who has come but briefly in contact with the welding and cutting industry realizes that the subject is extremely broad and that a person faced with the task of giving instruction in the subject must do a considerable amount of selection and organization of material.

Broadly speaking, a welding course will be taught by (1) a man having a good knowledge of the subject combined with ability and experience in teaching, (2) by a man having a good knowledge of the subject but with little or no experience in teaching, or (3) a man having little familiarity with welding and cutting but with teaching ability and experience. It goes practically without saying that the primary need for any welding instructor, regardless of the classification in which he may be placed, is a plan for the organization and presentation of the subject matter.

To supply the need for this plan for instruction, the International Acetylene Association has just published a book, prepared by its Oxy-Acetylene Committee, containing plans for courses in welding and cutting, and for training inspectors. Although this book was actually written during the past year, it represents the culmination of many years of contact with training programs and experience in the preparation of instruction material both by the International Acetylene Association and by its member companies.

The students appearing to take a welding course are found to have the widest possible variety of educational background. They may have had no industrial experience at all, or they may have had a number of years' experience in industrial plants. Their education may include a high school course, or it may be considerably less.

Industry's Requirement

On the other side of the problem, the industrial requirements for men who have completed a welding or cutting course vary considerably with the industry by which they are to be employed. As has been pointed out, some operators will be expected to develop into all-round repair, maintenance, or welding shop men, while others will be expected to specialize in work on one particular base metal. Furthermore, although a man may be employed for a particular type of work at this time, he may next month or a year from now be expected to do an entirely different type of welding or cutting.

Probably the best welding course is one that gives the students a thorough grounding in the basic principles and techniques of the process during the major part of the course, and then utilizes the last part of the time to give specialized instruction or a more general training, depending upon the circumstances.

With these thoughts in mind, and realizing that the primary requirement was for a work that would serve as a plan for giving instruction, this book of the International Acetylene Association presents in outline form the practice exercises and related theory that is desirable for most of the types of courses that will be given. The book is divided into three chapters: Chapter I giving the outline courses for the training of welding operators, Chapter II devoted to outline courses for cutting operators, and Chapter III outlining the essential information that should be included in a course for inspectors. An introductory discussion gives an explanation of how the outlines are organized and how they may be used most advantageously.

The Training Course

In order to provide for the flexibility required, the material in the book has all been assembled into self-contained units. Each unit contains the closely guarded related information that it is felt can best be given in one lesson, although of course in very few cases is it expected that the student will acquire the necessary mechanical dexterity to complete the unit in one session.

In Chapter I of the book these units have been assembled into what is considered the ideal order for the presentation of a general course in welding, for a course in aircraft welding, and for a course in pipe welding. The book also contains a general course for cutting operators, a course for the training of structural steel cutting operators, and a course for inspectors. These particular courses were selected because it was felt that the majority of the courses that are given are of one of these types.

Because of the self-contained nature of the individual units, they can be reorganized to present practically any other type of course that may be desired, although naturally it may be necessary in the case of specialized courses to make up other units to supplement those already given.

The Contents of a Welding Lesson

A welding or cutting course is naturally primarily planned to make it possible for the student to acquire mechanical dexterity in handling the tools of the process. This means, of course, that the majority of the student's time is devoted to actual practice. A good welding operator, however, must of course have a considerable amount of knowledge concerning the properties of the metals with which he works. Such information is not acquired wholly in the welding shop. Therefore, a well rounded course in welding should contain in each lesson four distinct features. These are:

1. *A Lecture.*—In the ideal course, the best plan is to have the lecture presented by a different instructor than the shop instructor, and in a different location than in the shop itself. The lecture should be devoted to the presentation of the theory related to the students' work and

Courtesy Hobart Bros. Co.

Welding will deliver a Victory.

should employ as many of the tricks and secrets of good teaching as it is possible to incorporate.

2. *Outside Study.* — To supplement the lecture or to review the material presented, an assignment should be made for outside study. A student starting the study of a new subject is nearly always very much interested in it, and advantage should be taken of this fact by making it easy for him to spend some of his leisure time reading about the subject.

3. *Demonstration.*—Before starting any practice exercise, the shop instructor should demonstrate it. During the demonstration there should be a free exchange of questions and answers between the instructor and the students, and care should be taken to point out the important factors. Every effort should be made to tie the demonstration in closely with the lecture material.

4. *Practice Exercises.*—The major part of the time in a welding course will be devoted to the practice exercises. Because it requires time for the muscles used in welding or cutting to develop so that they will be able to work for a full day, it is desirable, especially during the first part of the course, to keep the welding practice periods relatively short. The criterion as to whether the student is qualified to pass onto the next exercise should never be based entirely upon the time spent in practice, but always upon the quality of the work obtained.

In the I.A.A. Book, each unit contains (1) an outline for the lecture material, (2) a suggested reference from which assignments for outside study can be made, (3) recommendations for the operation that should be demonstrated and frequent suggestions as to the important points that should be discussed, and (4) recommended practice exercises, including suggestions as to the type of test that should be performed to indicate the quality of workmanship obtained. Here again, every effort has been made to keep the parts of the unit as self-contained as possible to allow for reorganization to fit the time available and the instructor's method of training.

Related Subjects

In planning any course of instruction, consideration should be given to the amount of time to be devoted to related subjects, a factor which will depend upon the previous education of the student. For instance, the amount of cutting that should be given to a welding student should be decided by the amount that he will be expected to know about cutting later. The same is true of such subjects as blueprint reading, shop arithmetic, and layout work.

Conclusion

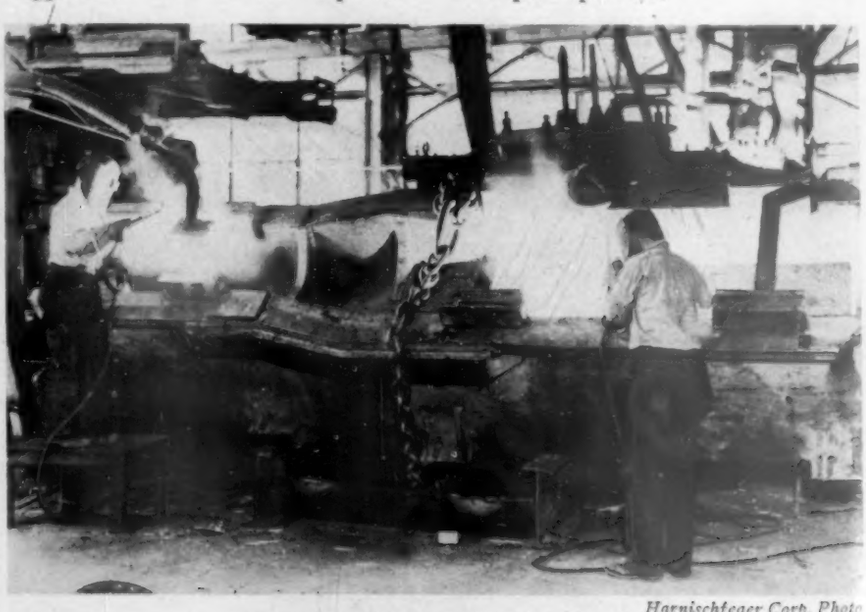
The first step in the preparation of a plan for the instruction of welding and cutting operators should be a decision on the basic objective to be attained. Then, upon the basis of the facilities that are available and the type of school that is to be used for the training, the plan of instruction should be organized so that at the completion of the course the student will be ready to meet the industrial requirements for an apprentice welding operator. The majority of the time in any welding course should be devoted to giving the student a basic training in the welding process such that he will be able to build upon this foundation through his industrial experience so as to become an expert operator.

Hydraulic Press Base

In the building of a new hydraulic press the manufacturer discovered that he would be unable to obtain a cast steel base for the unit for at least three months. Inasmuch as this unit was holding up vital production, it was decided to fabricate a welded base for the 475 ton press.

The base, which weighs 10½ tons, was fabricated from plates 2 to 2¾ in. thick in less than two weeks' time. Not only did welding save valuable production time through speedy fabrication but it actually resulted in a 10% saving over the older cast steel design.

This is just one of many examples of where priorities and material shortages have resulted in the redesign of machinery. In most cases redesign for welding results in a superior product which is less costly to produce. Welding provides greater strength per unit of weight as well as providing a ready, fast means of fabrication.



Harnischfeger Corp. Photo

Redesigned for welding saves 10% on this job.

Fig. 1—A 400,000 v. X-ray unit used in the inspection of welded boilers.

X-Ray Examination of Welding

By R. T. FOREMAN
The Kelley-Koett Mfg. Co., Inc., Covington, Ky.

X-ray examination is playing an important part in the development of welding techniques and inspection of welding in our war effort. Data on radiographic interpretation is given.

AN INCREASING demand for speed in production emphasizes the necessity of utilizing every possible method of eliminating waste of materials or man hours.

The elimination of waste and wasted effort is one of the major factors in the present day demands for rigid inspection. In the welding of armament, where the discovery of a defective weld may necessitate rejection there is a constant demand for greater knowledge of conditions existing in a weld so that improved welding methods may be developed. No single means has been more effective than X-ray inspection in contributing to the achievement of this goal. As a result this unique nondestructive method of testing and inspecting welds is becoming increasingly popular.

The first expansion in the use of industrial X-ray came during World War I. During this period, X-rays were used to detect flaws which might result in disastrous failure of equipment—high-pressure boilers, vital power mechanism such as turbines, flywheels, valves, etc. Thousands of vital castings and forgings were checked before finding their way into the ships which kept the sea lanes open. The Army installed X-ray equipment to be used at McCook Field (now Wright Field), Dayton, Ohio. At this field, model airplanes, which were tested in wind tunnels, were carefully checked by X-ray to locate points of weakness in internal wing structure and other concealed parts. High pressure valves and fittings of all kinds were also checked for defects which might have caused failures, at a critical moment of battle. At that time there was little use for the X-ray inspection of welds because welding was still considered a process of maintenance and repair rather than a process of manufacture.

Early Day Equipment

In the years that have followed, however, there have been many changes. X-ray equipment which at one time was bulky, dangerous and lacking in flexibility, had become compact, safe, flexible apparatus capable of yielding excellent results in the hands of the average employee. The equipment of the early day operated on low voltages requiring long exposure time, all of which greatly limited the uses of X-ray. This had been changed, too, and with the use of high voltage apparatus it is possible to X-ray castings, forgings and weldments of considerable thickness in a comparatively short interval of time. As the X-ray has changed, so has welding. It is now a vital production tool in America's war effort constantly being inspected and checked by X-ray.

The application of X-ray examination to welding has resulted in great improvement in the quality of welded joints. Defects resulting from entrapped slag, porosity, incomplete fusion and cracks are clearly visible on the X-ray film. In weldings as in castings, the examination reveals the presence as well as the nature of internal defects not discernible on the surface. As the X-ray beam passes through the material, it produces a shadow picture of the specimen. Variation in the shadow intensity indicates lack of uniform-

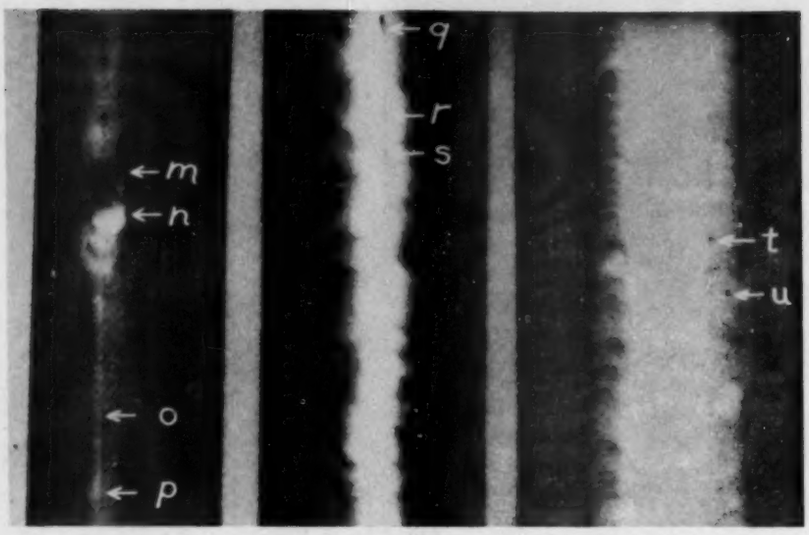


Fig. 2—Radiographs of weld joints. Radiographs (2a) and (2b) left and center, respectively, picture unsatisfactory welds while (2c), right, shows the appearance of a satisfactory weld.

ity in the material, and the causes of the non-uniformity can be deduced. Flaws amounting to as little as 2% of the total thickness—even as little as one-half of one percent in favorable cases—can be detected.

Modern Equipment

Fig. 1 shows a typical arrangement of apparatus in use at The Henry Vogt Co. plant, Louisville, Ky. With this unit, a 400,000 v. X-ray machine, routine examinations of welded boilers are made on a three-shift schedule. The X-ray unit is mounted on a movable truck and may be adjusted to any desired angle by means of motor-drive. It is completely shockproof and operator protection is afforded by the lead-lined booth at the rear of the truck. Heavy boilers are mounted as shown, while lighter parts are frequently handled by crane during examination.

Detecting Flaws

When X-ray analysis was first applied to industrial problems, it was with the idea of detecting flaws which might cause explosions or less serious breakdowns. Welding was recognized as being preferable to riveting in boiler work but blowholes, slag, incomplete fusion, or porosity might produce defects not visible on the surface, but resulting in dangerous internal weakness. It was customary to chip out welding metal over the defective spot and refill—a process which is still in use, conserving many finished units which might fail completely in a hydrostatic test at pressure above normal working range.

As data accumulated from radiographic inspection of finished welds, it became apparent that certain techniques produced welds superior to others. Although it is not possible to entirely eliminate cracks and flaws, great improvement in weld quality has been achieved. This fact is attested by the increasingly rigid requirements; porosity considered acceptable a few years ago would now cause rejection of a welded joint. A great deal of this improvement in quality is attributed directly to X-ray examination, which permits ready inspection of every portion of a weld —exterior, interior as well as edges and base metal.

X-Ray Inspection

Figs. 2a, 2b and 2c illustrate the type of work which is being done. Fig. 2a pictures an unsatisfactory weld. The grayish appearance of the joint indicates insufficient welding metal was used. Smooth edges on each side show a lack of penetration into the walls of the joint. At point "m", a blowhole caused piling of excess metal at "n". The welding metal also piled against the walls in a straight line from "o" to "p", with no penetration and no fusion.

Fig. 2b shows another unsatisfactory weld, although its surface appearance was excellent. The brilliant white line indicates an excess of weld metal in comparison to base metal. Hazy, irregular edges show that welding did not penetrate into the walls of the joint, and fusion was incomplete. Dark spots on the film at "q", "r", and "s" indicate entrapped slag, producing flaws of dangerous size.

Fig. 2c illustrates a completely satisfactory weld of unusual width. Relative density of the shadows indicates thickness of welding metal is neither too great nor too small, compared to thickness of the adjoining plate. The smooth edge and characteristic waves indicate excellent penetration and complete fusion, with flowing at the walls of the joint. At points "t" and "u" the film shows entrapped slag or gas bubbles, but dimensions of the defect are small and the weld is fully acceptable.

Improved Welding Technique

Between the weld obtained in Fig. 2a and that finally obtained in Fig. 2c, experimental welds show that the trough required widening and the welding temperature required changing. These modifications of technique were made with small, inexpensive pilot units, rapidly prepared and examined. It was unnecessary to experiment with the finished boiler, the defects were eliminated in advance rather than discovered after

Fig. 3—These diffraction patterns of a steel sample show the arrangement of molecules; under great strain (left), partially annealed (center) and completely annealed (right).

fabrication which would cause rejection of an expensive semi-finished unit.

The unpredictable behavior of many materials makes welding a difficult problem. X-ray analysis offers a positive method for developing correct operating procedure with minimum loss of time, and with assurance that a weld of maximum quality will be obtained. It is apparent that much information can be drawn from close scrutiny of even a single film. It is not necessary to examine every inch of every weld. Once the technique is established only an occasional film will be necessary to serve as check.

Machining Welds

When welded joints are used in materials which must later be machined, it is important that the welded surface present an unbroken exterior after machining. There is no known method, other than X-ray examination, of obtaining this information. A film will quickly show the presence of flaws, the defect can be filled, and machining can proceed with full assurance that no loss of material or machine-hours will be incurred. Sonic, magnetic, or electrical examination will frequently reveal the presence of defects, but X-ray examination goes much further by permitting accurate determination of size and location of such defects—the exact depth can be measured and exploration can be undertaken with the certainty of a surgeon wielding an instrument.

Stress Determination

The determination of various types of defects, which though invisible could be determined by destructive methods, is not the only use of the X-ray. By use of the diffraction method of X-ray analysis makes it possible to peer into the very composition of matter and visualize the arrangement of molecules. When a sample of the material is placed in the path of a narrow pencil of X-rays, reflection occurs from each molecule, and the film will record a circular image whose shape depends on the molecular arrangement of the material.

Fig. 3 shows three diffraction patterns taken of one sample of steel. The first pattern obviously differs from the other two—the reflections indicate that the molecules are arranged in haphazard fashion and are under great strain. The steel is then partially annealed and the middle pattern is obtained—the molecules are rearranging themselves in a more symmetrical pattern. Finally, after complete annealing, the molecules produce the pattern shown at the right of Fig. 3. They are symmetrically arranged and the sharpness of each line indicates that no strain exists.

Diffraction analysis is of great importance in the steel and alloy industries, where stresses and strains are a vital factor. A slightly different method (spectral analysis) is used, in which the X-ray beam and the specimen are arranged in such manner that a series of dark bands are obtained on the film. The position of these bands shifts according to the composition of the material and the degree of strain. It is the same sort of analysis, made with X-rays, that permits astronomers to analyze the light from stars and determine their temperature, composition, and speed. The uniformity of an alloy—the "solubility" of the metals with respect to each other—can be determined. Once again X-ray points the way to production of materials of complete homogeneity, free of defects which may result in disastrous failure in service.

Welded Swimming Pool

Two welded tanks form the outside forms of a huge swimming pool constructed at the New York World Fair Grounds.

Arc welding is playing an important part in the transformation of Fountain Lake, at the New York World's Fair site where Billy Rose held his famous Aquacade, into a permanent swimming pool large enough to accommodate 2,800 bathers.

Perhaps the most interesting construction problem has been to provide outside forms for the two deep diving areas. This is being solved by the use of two steel tanks 60 x 65 ft. in size, the building of which required the work of 12 weldors and helpers for 5½ weeks. The two all welded steel tanks of 5/16 in. plate were built in the dry on falsework over the piles for the pool's shallow portion. Bottom and side walls of tanks were stiffened by 20 lb. steel rails on 3½ ft. centers.

Completed tanks were raised by four 50 ton hydraulic jacks so that the falsework could be replaced by two 12 x12 in. wooden skids sloping toward the end of the pool where the tanks were to be used. After the tanks slid off these members, they were floated exactly over the position desired so that placing of concrete for the bottom and side walls could begin immediately.

As the concrete was placed it caused the tanks to settle and come to rest on foundation piles left on the site by the original Aquacade pool. Thus, the tank for the 12 ft. deep east diving area was sunk to 7 ft. below the lake level and that for the 10½ ft. deep west end 5½ ft. below.

The gradual slope of the inner faces of the side walls necessitated no inside forms for the construction of the side walls as high as the tanks. Above that level the side walls could be built in the dry by ordinary methods.

This construction is being performed for the park department of the City of New York under a $300,000 contract. Craftsmen Welders, Inc. of Brooklyn, New York are reconstructing the tanks.

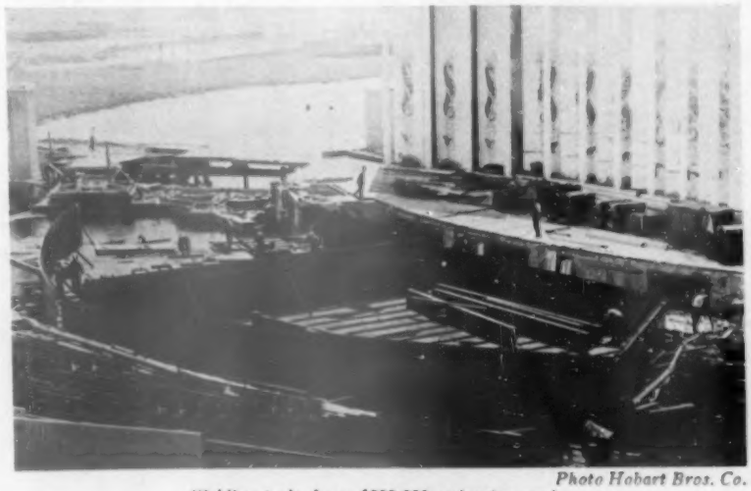


Photo Hobart Bros. Co.

Welding tanks for a $300,000 swimming pool.

Fig. 1—Portable gun welders greatly increased production because they can be employed in jig set ups effectively.

Production Spot Welding

Spot welding, both portable gun and multiple spot welding, is an important factor in war production of aircraft. Many of these applications were developed in the automotive industry

Portable gun welders which only a few months ago were making motor car bodies have joined the war effort, too. Censorship restrictions, however, will not let their important role be told at this time so this article is confined largely to the activities of the automobile industry before war struck.

THE EDITOR.

By **B. J. TODDSWORTH**
Consultant

PORTABLE GUN WELDERS are becoming more widely used in the fabrication of automobile bodies, radiator grilles and other light sheet metal parts required in the automotive industry. All because the portable welding gun is capable of making welds in close quarters that could never be reached by a stationary spot welding machine.

The portable gun welder is a variation of the conventional spot welder; differing from the conventional type only in the manner in which the electrodes are mounted. On the gun type welder there is one or more portable, air operated power type guns connected by flexible power and pressure leads to the cabinet containing the transformer, heat and pressure regulators, timing equipment and the necessary connections. Since the electrodes are mounted in such a flexible manner, the portable gun welder is especially adapted to the fabricating of parts that are assembled in jigs or for work that is bulky in character.

Spot Welding Difficulties

In the radiator and grill assembly department of a large automobile manufacturer considerable difficulty was experienced in obtaining satisfactory welds. Most of the accepted methods of assembling these radiator and grill units were considered prior to going into production. In trial production runs it was indicated that spot welding would be the best means for economical assembly. When production was started, however, it was soon determined that the conventional type of spot welding was going to be particularly troublesome because of burned spots and poor bond. Much of the work had to be repaired and at times some pieces were so badly burned that it became necessary to scrap the parts. In addition to these difficulties, costly shut downs and heavy maintenance delays were common due to the burning of the contacting devices.

It was found that many advantages could be gained in this department by the use of a gun-welder. In the assembly of radiator and grill units welds made by the gun-welder were

Fig. 2—Electronic controls are an important part of portable gun welding equipment.

found to be stronger and consequently fewer welds were required for the fabrication of these units. This feature greatly contributed to increased assembly speed. When these features were combined with electronic control devices for the accurate control of the flow of the current to the gun welder it was found that rejects and maintenance were reduced to a minimum.

Gun Welders

Soon this radiator and grill assembly department was equipped with six gun welders which are capable of joining 20 separate parts at 150 places in less than one minute. The setup for such an operation is shown in Fig. 1. Naturally, the fact that the 20 parts are mounted in jigs greatly facilitate the assembly as well as account for the increased speed. In all 17 electronically controlled gun-welders have been installed in the various departments of the body plant of this company.

In Fig. 2 may be seen the battery of electronic controls required for the six gun-welders used in the radiator grill assembly work. The two electronic tubes pictured in the open cabinet so accurately control the flow of current to the gun-welders that burned spots can be entirely avoided.

Welding Fixtures

Making spot welds in semi-inaccessible locations is one of the major problems encountered in the building of military aircraft. If it were entirely possible to spot weld all of the inaccessible places a great deal of time could be saved since the placing of rivets in some of these locations make for production bottlenecks. The automotive industry was one confronted with this same problem in the spot welding of reveal and garnish molding. On these applications intricately shaped, thin section spot welding electrodes used would not stand up under continued operation. As a result a welding fixture was developed which is now proving quite helpful in our nation's war effort. This welder was an unusual combination of short-circuiting gun and clamping fixture. In automotive welding this unit (Fig. 3) more than tripled production speed over previous welding methods.

Short-Circuiting Guns

The fixture suitable for either one or two man operation has an enclosed transformer short coupled to bus-bars which also serve as nesting discs for the work. A single hydraulically operated spot welding gun, of the short-circuiting type is used alternately by the two operators when production speeds require two man operation. In operation, the window reveal "A" is first secured against the bus-bar die "B" (Fig. 4) by means of thumb clamps. The garnish molding is then placed in position over the nesting die. This die is so designed that when the hand clamp brings the molding under tension, the molding is forced securely against the reveal.

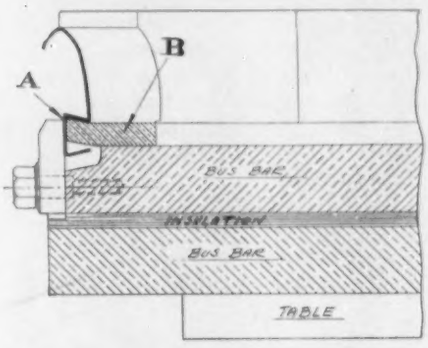


Fig. 4—Ingenious fixtures aid in speeding production by aiding in difficult welding operations.

Electrode Cooling

The gun used is of the pincher type, pressure being supplied by an hydraulic pressure booster. To permit its admission in the concave side of the garnish molding only the tip of the upper electrode is of relatively thin section. Thus ample cooling can be afforded to prolong electrode life. The lower electrode is of the button type contacting the bus-bar. Being suspended midway between the two operating stations, the welding gun is used by one operator while the other is placing and removing the work.

Multiple Spot Welders

This is not the only way, however, that the resistance welding experi-

Fig. 3—A two operator fixture employing a combination of a short circuiting gun and a clamping jig.

ences of automobile manufacturers is proving helpful in the building of bombers. In the building of wing sections, bomb bays and other large panels it is found advantageous to use multiple spot welding or, in some cases, multiple gun welding. Multiple spot welding is the development of the automotive industry that was brought about by the increased demand for faster production. In this increase in production speed, however, the safety features of the finished product could not be sacrificed. For this reason, it was necessary to build stronger and better cars. It was quite natural then that multiple spot welding would be the answer for by this means it is possible to weld a number of points at one time to obtain a near homogeneous structure. An example of this is shown in Fig. 5 where there is shown a large multiple spot welder used for the welding of underbodies of passenger cars.

The underbody consists of 20 or more individual parts which are to be fabricated by spot welding. Under such circumstances it is quite easy to see how it is possible to speed production if all of these parts can be mounted in a machine so that they will be held in place during the welding operation. Fig. 5 pictures the brackets and braces loaded in their respective positions ready to be welded to the major panel stamping which in this case will soon become the steel floor of a sedan body. The completely welded underbody may be seen in Fig. 6. It is now ready for the upper body assembly.

Poke Welding

In Fig. 7 is pictured a machine used in spot welding the coupe side panel and wheel housing. This is another spot welding machine that has been in use in aircraft production. In a machine of this type the parts to be spot welded are mounted in a fixture, the lower side of which is an electrode. It is now possible to spot weld at any point along this die by merely touching the electrode which in this case is held in the hand, to the panel to be welded. Known as poke welding, this type of welding makes it possible to weld inaccessible places or at places where it is not possible to conveniently have a lower electrode come in actual contact with the parts to be welded.

In poke welding the movable electrode is operated by hand somewhat like a riveting gun. The electrode is placed at the point to be welded and when sufficient pressure is exerted, a pressure switch is actuated turning on the welding current. Often this type of welder is not fitted with a timer to automatically shut off the current so much of the success of this type of welding depends on the operator's judgment.

Just as many of our automotive plants have been converted to the building of armament much of the experience gained in the manufacture of automobiles is being converted advantageously to the building of these armaments. It is in this field that the resistance welding experiences of automotive manufacturers are being used to a decided advantage in our war effort.

The illustrations in this article are credited as follows: Figs. 1 and 2, Westinghouse Elec. & Mfg. Co.; Figs. 3 to 6 incl.; Progressive Welder Co. and Fig. 7, Taylor-Winfield Corp.

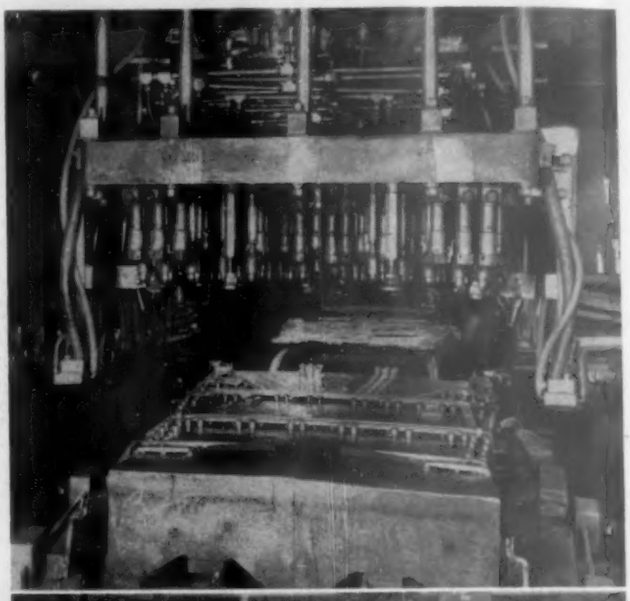


Fig. 5—A multiple spot welder capable of over 100 welds during one operating cycle.

Fig. 6—All the welds in this underbody are made during one setup.

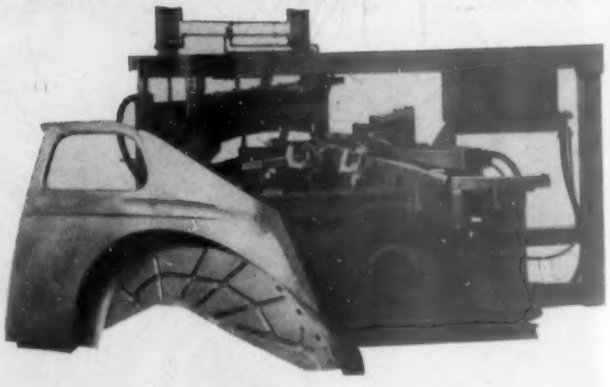


Fig. 7—Fixture welder for Hydro-Pneumatic spot welding coupe side panel and wheel housing.

Wear vs. Hardness

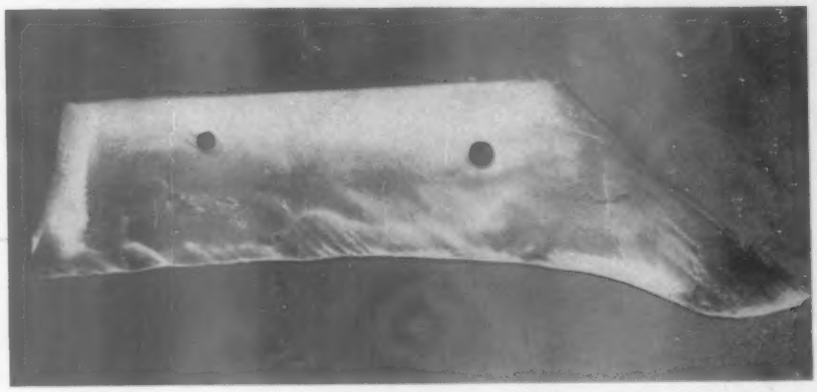


Fig. 1—A hard-faced plow share after having plowed 550 acres (compare with Fig. 3).

Hard-facing materials resist wear because they are designed for that particular purpose. It is because of this that softer hard-facing deposits outwear hard alloy steels.

By **J. C. MENZIES**
Vice-pres., C. E. Phillips & Co.
Chicago

THE HARDNESS of various alloys has been emphasized to such an extent that the average individual seems to regard this factor as the ultimate in hard-facing metals. It is, of course, true that practically all hard-facing metals are of the hard type alloy, but it is also true that there are many alloys in common use which possess great hardness but which could not be termed hard-facing alloys. For example, take high speed steel. This type of alloy, in the heat-treated condition, is considerably harder than the majority of hard-facing metals because such extreme hardness is essential for cutting efficiency. High speed steel, however, was not developed for wear-resistance, and consequently does not contain the properties necessary for resistance to abrasion.

Generally speaking, the hardness of both heat-treated alloys and of facing alloys is spoken of in terms of Rockwell C and will vary, according to the type of material, from Rockwell C30 to Rockwell C65.

In alloy steels, which are to be used in their heat-treated condition, hardness and strength are of prime importance. These steels, metallurgically speaking, are designed to offer maximum strength with maximum hardness. Steels of this nature are not made for wear-resistant purposes. In hard-facing metals, the ability of the alloy to withstand severe abrasion or wear is most important. Applications to which hard-facing alloys are put vary to such a large degree that it is necessary to combine properties other than wear-resistance in their make-up. Resistance to impact, resistance to heat, and resistance to corrosion are very essential properties. One or combinations of these properties can be found in most hard-facing materials, combined with the utmost in wear-resistance. The fact that a hard-facing alloy is to be subjected to severe impact does not mean that it must be of the softer variety.

A great deal of experimental work has been done regarding hardness and its importance in resistance to abrasion. These tests have been made both experimentally and on practical applications. The results indicate quite conclusively that hard-facing materials, which have a hardness of Rockwell C45, withstand wear and abrasion in ratio of from two to one, to as high as ten to one over the best quality of heat-treated alloys having a Rockwell C hardness as high as 65.

Although it has been found that the wear resistance of alloy steel increases with hardness, this particular property does not hold true with hard-facing alloys. While every attempt is made to maintain a constant hardness for the various types of hard-facing products, the particular hardness of any one metal is controlled by the type of alloys of which it is composed. In other words, the hardness of any hard-facing material is an indirect property, resulting from the attainment of the desirable amount of wear resistance in combination with other properties essential to the alloy for a particular application. The wear-resistance of any alloy depends not only on the amount

of alloying element or elements contained in the steel, but also depends on the particular kind of alloy which it contains. Alloy steels of the so-called mild type, with an aggregate of 3% to 6% alloying material as well as high speed and stainless steels containing as much as 25% to 30% alloying materials, have a certain definite amount of wear-resistance as compared to mild steel, regardless of whether or not they are in the hardened condition. The wear-resistance of these steels will increase by heat-treating in approximately the same ratio as a good grade of carbon steel subjected to heat treatment. Heat treatment of high carbon or alloy steels often raises the hardness from 10 to 65, Rockwell C. Increased wear-resistance, due to increased hardness, in some cases may double the life of the part. Assuming the life of the part to be double when heat-treated to a Rockwell C65, it is possible by hard-facing to increase the life of this heat-treated part several times.

Hardness Secondary

Hardness in connection with hard-facing metals is of secondary importance. The real purpose of hard-facing is to retard wear. Consequently, in the selection of the proper type of hard-facing metal, the question is: "Which one will wear the longest?" Not, "Which one is the hardest?" Taking into consideration other factors such as heat, impact, corrosion, etc., the question of which one will wear the greater length of time is naturally much more important than the hardness of the hard-facing alloy used. If hardness were the deciding factor in facing metals, then it would only be necessary to obtain a steel which could be heat-treated. It would then be possible not only to secure the same hardness as obtained by hard-facing, but to secure a hardness in excess of hard-facing materials. Such practice would, however, give only additional hardness and not to any extent additional wear or abrasion resistance.

Fig. 3—Before being placed in service plow shares are hard-faced (upper) and they show very little wear after plowing 250 acres. An unprotected share must be re-sharpened after 21 acres of plowing.

Grinding

One of the most common ideas regarding hardness (which is entirely erroneous) is the question of hardness in relation to the apparent ease or difficulty with which any particular alloy can be ground. In considering a grinding job on any piece of heat-treated or ordinary steel, there are never any anticipated difficulties in which hardness could be considered as taking part. In other words, it is comparatively easy to grind any type of heat-treated steel regardless of its Rockwell C hardness. In the case of hard-facing materials, however, other elements enter into the picture; it is quite common to have serious complaints in connection with the machinist's inability to grind the material without using a great deal of time and losing considerable wheel. However, it should be remembered that hard-facing alloys have been developed to resist the action of grinding wheels (which is one type of abrasion) to the maximum extent. Consequently, it is to be desired that the hard-facing material be as difficult to grind as possible in order that the facing resist the wearing action for which purpose it was intended. It is significant that the difficulty of grinding has little or no connection with the hardness of an alloy, particularly when that grinding is to form the base of a comparison between heat-treated steel and a facing material. Of course, all hard-facing materials are comparatively hard to grind, but a heat-treated alloy of the same hardness or considerably greater hardness, can be ground with comparative ease. As an example, we could take a shaft which has been hard-faced. The average machinist in grinding this shaft will complain, not particularly because it is so difficult to grind, but rather because it is too hard to grind. This is entirely erroneous. Actually the hard-facing deposit is not as hard as heat-treated high speed steel, it was developed for the purpose of resisting the action of a grinding wheel or any other type of abrasion, so it is to be expected that a hard-facing deposit will be difficult to grind. Inasmuch as the high speed steel was not developed to resist the action of grinding, it is natural to suppose that it can be ground with comparative ease. Regardless of the relative hardness of these two materials or the relative hardness of any hard-facing metal and any heat-treated or high carbon alloy steel, it can be definitely stated that the hardness can not be estimated with any degree of accuracy by the relative ease or difficulty with which these two types of materials can be ground. Always grind to see how hard it is. It is possible to get a rough estimate as to the wearing properties of various hard-facing materials by a comparative grinding test, which, however, will not indicate the actual or approximate hardness in comparison with the hardness of various alloys and heat-treated steels. Some hard-facing materials have been designed to resist the action of grinding to a maximum degree comparable with other properties incorporated in the alloy which may be desirable for its intended use.

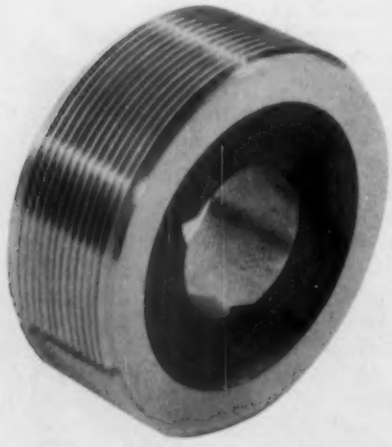


Fig. 2—A thread gage made of cold rolled steel and hard-faced. This gage lasted for sixty days as compared to four hours for heat treated tool steel gages.

Carbides

It should be understood that hard-facing materials, which are composed of tungsten carbide or those welding rods commonly in which tungsten carbide forms a large percentage of the whole, cannot be considered as homogeneous alloys when deposited. In their application the deposit is composed of particles of tungsten carbide contained in a matrix of relatively soft metal. The abrasion resistance

Fig. 4—With the proper facilities a welder will hard-face four to five hundred undercutter bits per hour.

Fig. 5 — Hard-facing of crawler tractor rails is a necessity with present material shortages.

of these deposits depends entirely on the amount and distribution of the tungsten carbide particles. Tungsten carbide is usually compared with the diamond relative to its hardness, due to the fact that this carbide has a hardness which approaches that of the diamond. However, it appears that the actual hardness of this material is used as a basis from which its great wear and abrasion resistance can be estimated. Without question tungsten carbide for hard-facing uses offers the ultimate in wear resistance. However, it is entirely within reason to think that the wear resistance of tungsten carbide is a function of its properties. In other words, the hardness of tungsten carbide is a contribution but could not be considered as the sole reason of the outstanding resistance to abrasion which this material possesses.

Hardness and Abrasion

A very good example of the relationship of hardness to abrasion resistance is to be found in the application of the so-called tough type of tungsten carbide as compared with the regular or 100% tungsten carbide alloy. The toughness of the tough carbide is obtained by the addition of small amounts of alloys, usually Cobalt. This addition to the carbide has a pronounced effect upon the hardness of the product, making this alloy softer than regular tungsten carbide. While this alloy is softer and has a tendency to round off in practice, the actual wear-resistance of this material is comparable with that of the harder type of carbide. This, however, applies only to wear-retarding applications. The greatest use of tungsten carbides are for earth cutting implements, particularly to the oil welling industry. For this type of work it is necessary to have the harder type of alloy in order that the greatest cutting efficiency be maintained. For this reason it is desirable to apply this material in such a manner that the use of the implement will afford an opportunity for the extremely hard and relatively brittle carbide to break off; thus exposing new and sharp edges and points for the cutting action of the implement or bit. The use of the tough type carbide in this application would defeat the very purpose for which a carbide faced bit or implement has become famous. In the action of the cutters on the earth, it is only logical to suppose that the more sharp surfaces exposed to the work, the more hole that sharp surfaces will cut. The tough type carbide is a material which does not break off readily nor does it continuously expose new sharp surfaces, instead it wears away to a rounded blunt end and relies entirely on its ability to resist wear for its cutting action. We have a situation very similar in nature to the one of hardness in relation to hard-facing alloys. When we want an alloy that will retard wear to a maximum degree, we get that particular alloy regardless of its hardness. The same thing applies to earth cutting tools. When we want a facing that will cut, we get the alloy that will do the most cutting in the least time with the least effort and power.

Hardness and Wear

So far as the question of hardness versus wear resistance is concerned this subject deals with the hard-facing materials which are the homogeneous type only. In the choice of the correct hard-facing material to use for any application, it becomes necessary to consider all the various

Fig. 6—These tool joints have drilled 25,000 ft. of hole yet show little wear in their hard faced areas. 21,000 ft. is usually the life of a tool joint without protection in the same oil field.

Photos page 45, 46 and 47 Stoody Co.

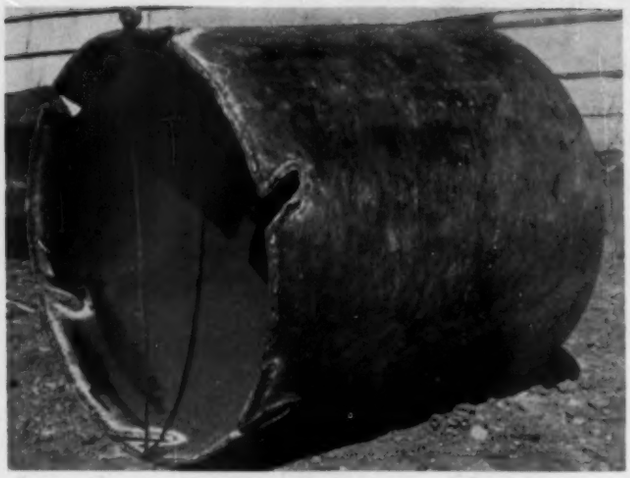


Fig. 7—Hard-facing greatly increases the effectiveness of core drill bits.

factors which have a bearing on the problems, such as impact, heat, corrosion, etc. The proper selection rests in a hard-facing rod that will have the desirable properties in sufficient amount to meet these secondary conditions and at the same time assure that the hard-facing material selected will deliver the maximum resistance to wear consistent with the various other properties desirable. It may be definitely stated that with the choice of the proper facing material for any application, the question of hardness of the facing alloy may be entirely ignored.

Hard-facing Pointers

Now one thing must be kept in mind. No one particular metal can meet all requirements. Therefore the user must use reasoning and make some study of the various problems to enable him to make a proper selection of the hard metal for the job. He must particularly bear in mind the kind of abrasion which will be encountered, whether there is shock or impact, if there are elevated temperatures to be considered or combination of these things.

Now we have covered hard-facing vs. wear-resistance, price and the selection of the proper material. Therefore, let us discuss the problem in the shop. I might say that this covers a very broad front. Considering that your shop may be doing general production work; it might be a machine shop doing only machine work; it might be a repair shop repairing all types of earth working equipment, agricultural tools, etc. Or it might be a shop on special armaments but in any and all cases, hard-facing fits some part of your operation.

If the shop were doing general repair work they might use some of each of many hard-facing rods. Possibly your shop is in connection with a mine—in that case you will be interested in increasing the life of under cutter coal bits, loading machines and conveyors. Possibly you have a machine shop to take care of the various river boats and dredges, particularly let us say the government repair shop located on the river. They would be interested in material for salvaging and repair pump shells, impellers and many other parts of dredging equipment.

In armament plants you are using tools, jigs, dies, electric hammers, and possibly your maintenance crew is operating air guns for spraying concrete. Then again in this territory you have a large railroad shop where they use some of our products on conveyor screws, anvil castings, equalizers, hangers and locomotive spring rigging.

In fact, there are a hundred applications on which hard-facing could be used to advantage. But regardless of the job—the use of a few pounds of hard-facing material will salvage many hundred pounds of steel and in the present emergency I need not express its importance.

THE END

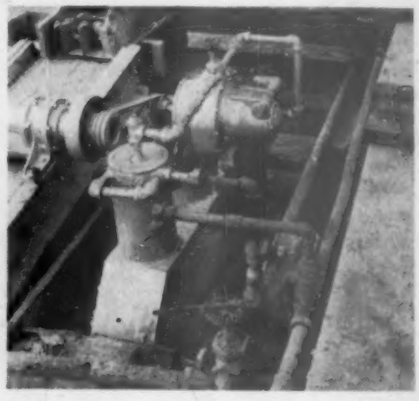
RETURN THOSE EMPTY GAS CYLINDERS

» «

Steam Separator

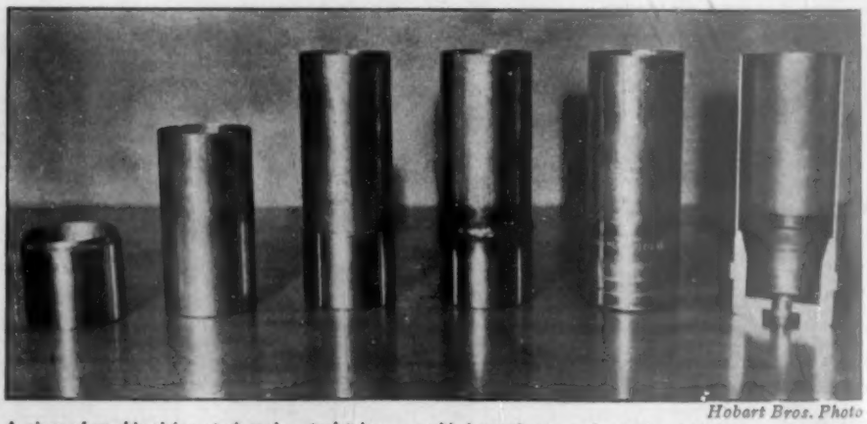
To protect the small turbine used to drive the shale shaker at a drilling rig, the company weldor devised a compact separator which was welded directly to the machine foundation and thus became an integral part of it.

The body of the device was a short vertical section of 8 in. pipe, into the side of which was welded, about midway, a nipple carrying within the cylinder a nipple extending almost to the base. At the top, and tangential to the cylinder, a second nipple was welded, through which the steam entered, being given a whirling motion which effectively threw out and permitted to settle any water carried by the steam. Centered in the flat top welded onto the cylinder was a third nipple, this serving to carry the de-watered steam to the turbine.



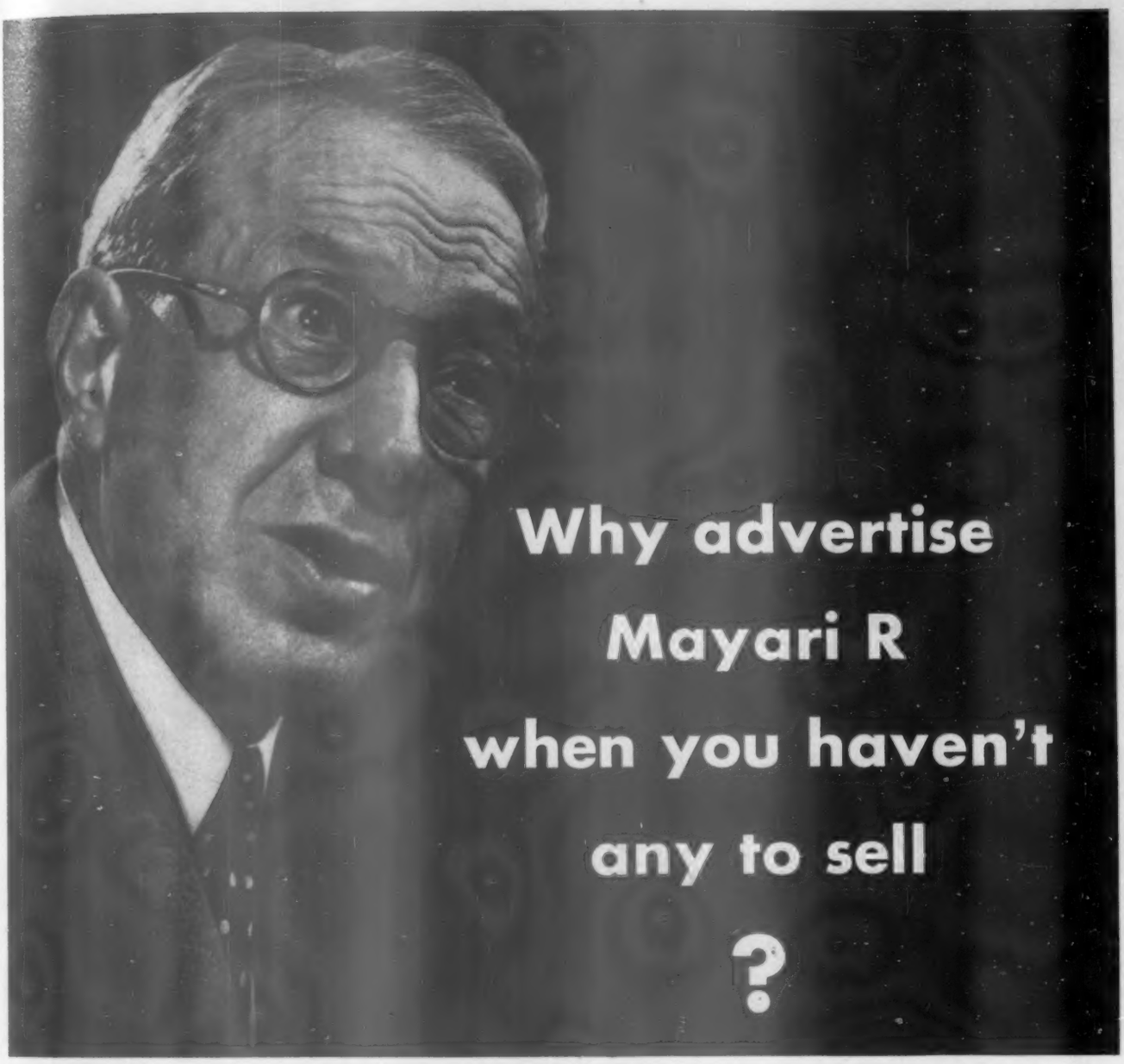
The welded separator removes the water from the steam.

Any steam condensation or water slugs settling to the bottom could be emptied through the side entering nipple, being blown out by steam pressure. During cold weather or prolonged rains the device was covered with an inverted 30 gal. drum, in which slots were cut to permit slipping over the three pipes.



Hobart Bros. Photo

A piece of machined bar stock and a steel tube are welded together to make steel cartridge cases as is shown in the steps from left to right.



Although Mayari R is being produced in large tonnages, it is true that there isn't nearly enough to go round. Because of its weight-saving this high-tensile, low-alloy steel has proved itself a natural for gun carriages, tanks, Army trucks, and a lot of other mobile equipment. And war needs have first call, naturally.

But that doesn't mean that there has been any cooling of our interest in those commercial customers who under normal conditions would be today the biggest users of Mayari R. We are appreciative of their past business. We regret that the necessity of winning a war prevents our filling their orders now, and are looking forward to supplying them when war demands subside.

In the meantime, we want to keep them informed about Mayari R, and to tell them from time to time of some of the ways in which this weight-saving steel is contributing to the war effort. We are sure that peace-time users will be glad to know that the Mayari R that normally would be coming to them is being used to good effect in a great cause.

There's another large group to which Mayari R advertising is directed: the thousands of men who today are rapidly advancing to key positions in war industries. Not only now but in facing future problems many of these men may find it advantageous to know about high-tensile, weight-saving Mayari R.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

What is the Future of Arc Welding?

THERE IS no doubt that the development in electricity, communications, transportation, chemistry and their allied industries has been greater in the past fifty years than during the million of years before. In view of this great development, we can only conclude that we have not come to the end of our road. There will continue to be new ideas, designs, materials and products.

Electric arc welding has already been an important factor in some of these great developments. It is, however, well to remember that welding is very much in its infancy. It is only since the development of the shielded arc electrode, about 1929, that electric arc welding received its great impetus. There was considerable welding prior to this period, both in manufacturing and repair work, but the development during the past twelve years has greatly over-shadowed the work done with this process during all the years previous.

The fact that an arc-welded joint, if welded with a shielded arc electrode, produces a joint stronger than the parent metal, if the joint is of equal cross section, and does this at a low cost, is the most important factor of the arc welding process.

The Welding Operator

One important reason for the great development in the welding field is the fact that the men engaged in this industry have foreseen the possibilities of this process. The welding operator who is an important cog in this wheel, has been able to produce, in most cases, good welding and this has helped in the expansion of the industry. One of the most important essentials of a good welding operator is to do first class work. I like to think of a welding operator as a person who is a skilled workman or craftsman, who has developed the art of arc welding. He is a crusader in a new industry, alert and progressive in his art.

A welding operator who applies his skill and ability should be able to produce first class welding. An attitude of indifference or routine not only hinders the welding industry but is not fair play to your fellow operator. The motto for all welding operators should be "Quality Welding." We cannot hope to develop the arc welding industry, and produce more and better jobs before the fundamental factor, to produce good welding, is mastered. It is only logical to conclude that quality welding is associated directly with the development of the welding industry. Personal advancement is also associated with "Quality Welding." The better the welding, the more products there will be manufactured by this process, and the more work there will be for welding operators, supervisors and welding engineers. About 15 per cent of the welding possibilities have been mastered so far, so that we have 85 per cent to develop. There is no doubt that the amount of welding will increase.

We must know the possibilities of arc welding. The applications of this process are fourfold. First is repair work; second—arc weld surfacing; third—replacing rivets, and fourth—making possible the replacement of castings by structural steel.

Repairs by arc welding are too well known for much discussion. It is, however, worth mentioning that millions of dollars worth of equipment is salvaged yearly with the arc. Without welding, broken parts could not be salvaged, and this would mean replacement with new parts or structures. Arc welding makes it possible to repair broken parts without the necessity of replacement, and the finished job is as good as the original at a very small fraction of the cost of the replacement.

Wear Resistance

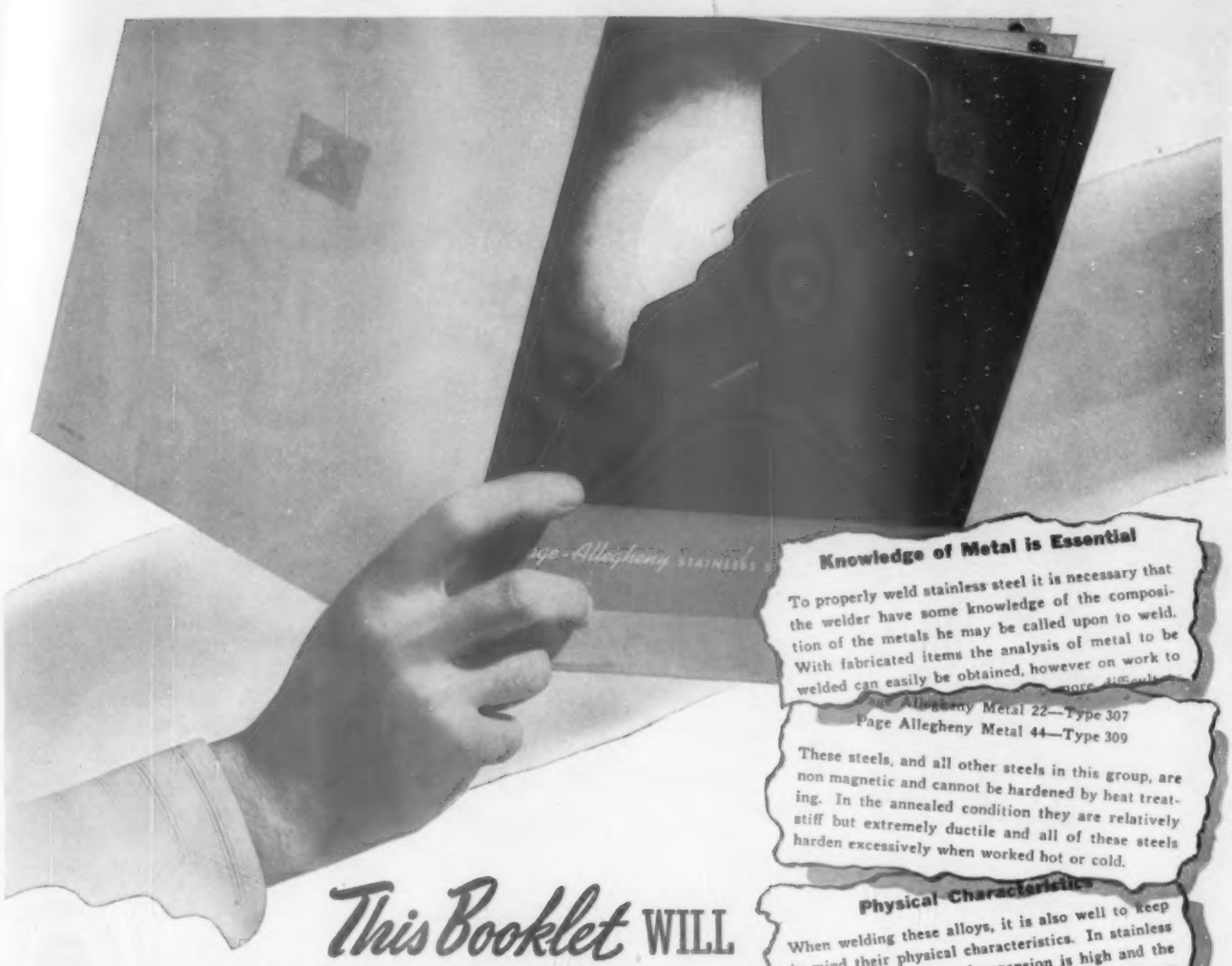
Another use for arc welding is the application of a thin coating of special alloy to a product to resist wear, abrasion and impact. It is possible to apply a surface of special alloy at low cost and give greater service than would be possible if hard surfacing were not used. Equipment such as excavators, crushers, railroad switch parts, and cross-overs and many others, can be surfaced at their vulnerable points and the life of the part can be increased tremendously. Heretofore, most of this work has been done on parts that were damaged or worn severely. The present trend is to apply this hard surface on new products before put into service and repeating the operation as soon as the weld metal has been worn away.

The replacement of rivets by a welded joint is certain because no riveted joint can be made as strong as the parent metal. The importance of arc welding rests on the fact that the welded joint can be made stronger than the parent metal. A riveted joint that would approach the strength of the parent metal would be so expensive that it could not be considered because of the low cost of full strength welded joints. There is some doubt in the minds of those who condemn the process. In some cases the hull of a ship cannot be welded, although in many cases boilers carrying a very high pressure inside the vessel are welded. That arc welding is reliable is proven by the fact that no insured pressure vessel has ever failed. Some authorities restrict welding in building structures on the assumption that it is dangerous to human life. We go into a concrete building and think nothing of it, yet there is danger there because we do not know what is in the concrete.

On the assumption that welding in structure is dangerous, the automobile would be a risky way to travel. There are about 32,000,000 cars in the United States and Canada, and these are largely all welded. If welding were not safe, then our lives must be in jeopardy. As far as can be determined, there has not been any loss of life due to welding being unreliable in this industry. A well-known arc welding authority made the following statement recently. "The great loss of lives on our fighting ships will be tremendously reduced when welded construction becomes universal. Except in extreme cases, the explosion of a torpedo in the vicinity of a ship with welded hull plates does not cause disastrous effects. The explosive impact simply dents in or buckles the welded plates

(Continued on page 63)

An address by M. N. Vuchnich, President, Lincoln Electric Co., of Canada, Ltd., to the Toronto Welders' Study Assn.



Knowledge of Metal is Essential

To properly weld stainless steel it is necessary that the welder have some knowledge of the composition of the metals he may be called upon to weld. With fabricated items the analysis of metal to be welded can easily be obtained, however on work to

Page Allegheny Metal 22—Type 307
Page Allegheny Metal 44—Type 309

These steels, and all other steels in this group, are non magnetic and cannot be hardened by heat treating. In the annealed condition they are relatively stiff but extremely ductile and all of these steels harden excessively when worked hot or cold.

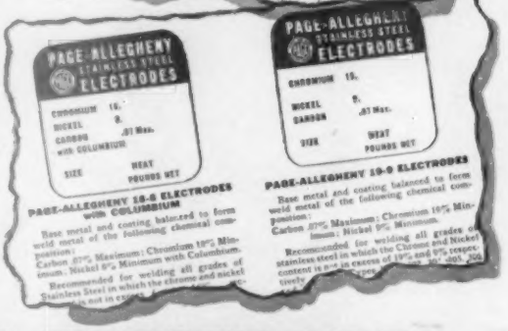
Physical Characteristics

When welding these alloys, it is also well to keep in mind their physical characteristics. In stainless steels, the coefficient of expansion is high and the heat conductivity is low, therefore, when setting up a job for welding these factors must be taken into account and allowance made for expansion and con-

STANDARD GRADES

The following list shows standard grades of stainless steels. Those which are not included in the standard classif on special order.

GRADE	TYPE NO.	CARBON	CHROME	
Allegheny 17/7	301X	.10-.20	16.00-18.00	
Allegheny "C"	302	Over .08-.20	17.00-19.00	
	302B	Over .08-.20	17.00-19.00	
Allegheny Metal F.M.*	303	.20 max.	17.00-19.00	
Allegheny "A"	304	.11 max.	17.00-19.00	
Allegheny "B"	305	Over .05-.20	18.00-20.00	
Allegheny "B" Spec.	306	.11 max.	18.00-20.00	
Allegheny 22		Over .08-.20	19.00-22.00	



This Booklet WILL HELP YOU SAVE TIME AND MATERIAL

..AND GET BETTER STAINLESS STEEL WELDS

WITH Stainless Steel on the critical list, it has become vital to take every possible means to conserve it.

It is worthwhile, for example, to instruct your men not to bend the electrodes and to use every one right down to the holder. Waste no part of them that can be used.

Then get the kind of information contained in this booklet by PAGE. It lists 42 grades of Stainless Steel with their type number and analyses. It lists the electrodes to use with these. And it gives such needed data as the physical characteristics of certain well-defined groups of "Stainless"—their reaction to heat and to cold working, etc. It gives such definite instructions as correct amperage and voltage; polarity, length of arc; direction of arc; starting the weld; preventing undercutting, etc.

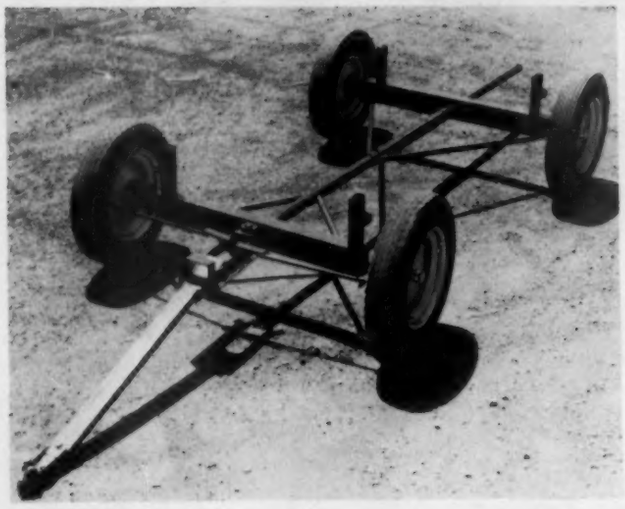
Ask your local PAGE Distributor for a copy of this booklet.

PAGE WELDING ELECTRODES

PAGE STEEL AND WIRE DIVISION • MONESSEN, PA., ATLANTA, CHICAGO, NEW YORK, PITTSBURGH, SAN FRANCISCO

AMERICAN CHAIN & CABLE COMPANY, Inc.
BRIDGEPORT • CONNECTICUT

Brief Sketches of Welding Jobs



A wagon of welded construction for farm uses.

Photo courtesy Hobart Bros.

Welded Wagon

Job shop operators who are searching for salable items to build in their spare time should consider this welded Wonder Wagon built by Doc Fixit's Repair Shop, Mt. Vernon, Ohio. According to Dow Caldwell, Jr., owner of the shop, his shop has already sold 54 of these farm wagons—netting a very nice profit.

These Wonder Wagons, weighing only 400 lbs., are guaranteed to haul 5,000 lbs. If Essex parts are used instead of Chevrolet parts, a 6,000 lbs. load can be handled. The entire wagon, with its all welded frame, can be built from used auto parts. Hitch takes any standard 4 in. tongue. Wagon measures 38 in. between stake pockets and telescopes to 10 ft. 6 in. between bolsters. It is provided with a swivel action 2 in. coupling pole; 3 in. channel stake pockets and 5 in. I beam axles. For travel over rough terrain, the wagon can be equipped with brakes or a rocking type bolster. Models can be built with ground clearance of 12 or 17½ in.

The Wonder Wagon can be built to sell, without tires, for $60—making a nice profit for the job shop owner. Two men can easily pull a three ton load on this wagon over level ground. But its major use is for high speed travel over highways.

» «

Safe Edge Bench

Loss of small parts, such as balls and rollers from bearings in process of overhaul, led the welder for one construction company to apply a fixed stop or safe edge to the steel surfaced work bench.

The stop consisted of a length of half-inch round rod, welded to the top of the bench some 3 in. from the outer edge. A light bead was run the length of the rod between tacks, so as to present a continuous stop against which small parts could roll without getting off the bench. A space of some 15 in. at one end of the bench top was left open to permit drainage of rain water, and also to simplify the cleaning of the bench.

The comparatively small rod, being welded securely throughout, did not interfere with the use of the bench top for overhauling heavy equipment, but rather speeded such work by permitting a bar to be slipped under the edge for prying it up enough to insert hook or lifting chain, and also to give drainage space when dirty equipment was washed with solvent or flushed down with steam hose before beginning actual overhaul.

A "galley" rail for the field work bench.

» «

BUY WAR BONDS

» «

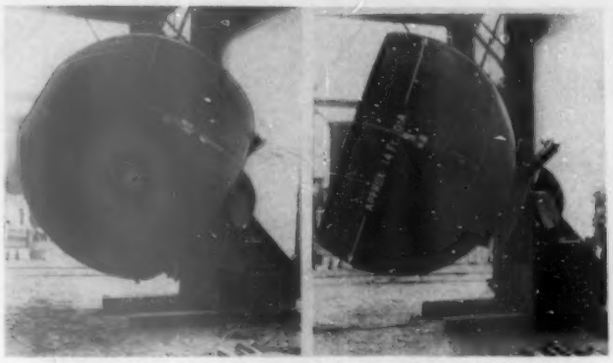
Morale Building At Harnischfeger Corp.

"BEAT THE SCHEDULE" worker program proves real stimulant for already stepped-up production schedules at Harnischfeger Corp., Milwaukee, Wis. Photo shows worker production committee in welder plant checking up on progress of welder division's output which is indicated on large colorful billboards in the plant. As scheduled work is advanced, symbols representing a given number of units on billboards are moved down until loaded on "U. S. War Special" train. The idea is to get finished work on car ahead of scheduled completion date.

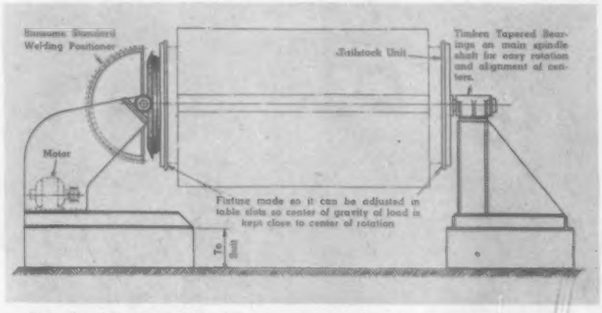
"Beat the Schedule" and win the war.

There's a *Ransome* Positioner For Every Welding Requirement . . .

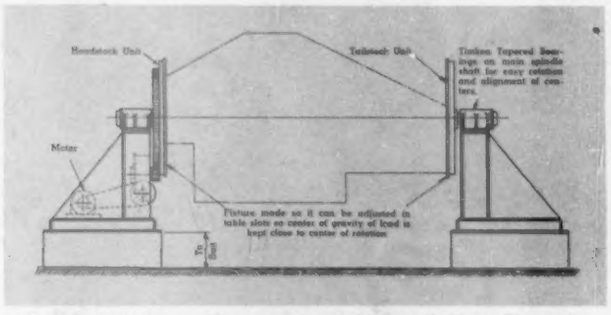
Standard Ransome Positioner used with an adjustable roller stand as an outer support . . . for handling long cylindrical pieces, such as pipes, tanks, etc.



Standard Ransome Positioner fitted with extension brackets . . . for handling work larger than the table top, such as tanks, frames, etc.


Ransome Standard Welding Positioner
Tailstock Unit
Timken Tapered Bearings on main spindle shaft for easy rotation and alignment of centers.
Motor
Fixture made so it can be adjusted in table slots so center of gravity of load is kept close to center of rotation
Sub-base

Standard Ransome Positioner with table set in vertical position . . . used as a head-stock unit. Standard Tail-stock unit is used at opposite end as shown.


Headstock Unit
Tailstock Unit
Timken Tapered Bearings on main spindle shaft for easy rotation and alignment of centers.
Motor
Fixture made so it can be adjusted in table slots so center of gravity of load is kept close to center of rotation
Sub-base

Standard Ransome Head-stock and Tail-stock Unit. The tail-stock is placed to accommodate objects of various lengths. Sub-bases are provided to meet height requirements.

Ransome Positioner with standard base frame and variable speed table rotation . . . for welding circular objects.

Ransome Positioner equipped with an adjustable base . . . used to get extra height for irregular-shaped pieces. Constant-speed table rotation in forward and reverse directions is operated through remote push-button-control station.

Write for Bulletin 200W

INDUSTRIAL DIVISION

RANSOME CONCRETE MACHINERY COMPANY

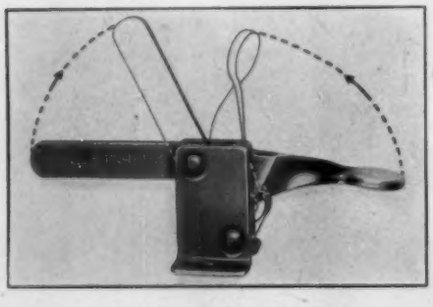
DUNELLEN **NEW JERSEY**

New Product Developments

A neoprene coated jacket for the weldor.

Safety Clothing

★ A new line of safety clothing has been announced by the **Safety Clothing & Equipment Co.**, 7016 Euclid Ave., Cleveland. Known as **Neoprene Coated Clothing** there is included many items used by weldors — welding jackets, aprons, sleeves, coveralls, leggings and gloves. This clothing is said to provide protection against heat, sparks, splash, acids, chemicals and oils. Most items are available in light or heavy weight material. A new folder describing this Neoprene Coated Clothing has just been issued and will be glad to forward to interested parties on request.



This small clamp is quick acting.

Small Aircraft Clamp

★ To meet aircraft demands for a small size, horizontal type toggle clamp, the **Detroit Stamping Co.** announce the new **De-Sta-Co Toggle Clamp No. 205.**

When in locked position this clamp measures only 1⅞ in. high, and 5⅛ in. from tip of handle to tip of arm. Weighs but 3⅛ oz. Handle and arm are in horizontal position when clamp is locked, thus providing clear working space from above. The manufacturer claims that although small in size, the clamp design and type pivot pins used prevent any undue looseness of parts. Structure is rigid, yet clamp is always free and easy acting.

Respirator

★ **American Optical Co.**, Southbridge, Mass., announces a new respirator for protection against toxic dusts. Representing an entirely new design in toxic dust respirators, this new **American R9100-T** respiratory protector is light in weight and gives full vision. The entire face piece is itself a filter and compresses maximum protection area into minimum space.

The closely felted, laboratory-tested filter has been approved by the U. S. Bureau of Mines for protection against the inhalation of toxic or poisonous dusts such as lead, cadmium, arsenic, chromium, manganese, selenium, vanadium and their compounds. The easily adjusted face piece with its leak-sealing cantilever edges of pure, pliable rubber

Complete protection against toxic dusts claimed for this respirator.

gives real face-fitting comfort. The simple, non-reversing exhalation valve is said to give positive protection. The double headband of solid, sanitary rubber holds the respirator (which weighs only one and a half ounces) in place without noticeable tension — will not force mask-edges into face.

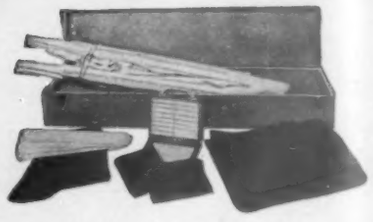
» «

Insulating Varnish

★ The **Sterling Varnish Co.**, Haysville, Pa., has recently developed a new insulating varnish, designated as **S-110**, for application to electrical apparatus that must operate at abnormally high temperatures. Tests have indicated that S-110 will stand operating temperatures at 250C. or higher.

When baked at 175-200° C. it dries all the way through the deepest winding and does not resoften when exposed to high operating temperatures. The dried film is mechanically strong, exceptionally adhesive and flexible, and retains these characteristics under adverse heat conditions.

The manufacturer will be glad to furnish additional information upon request.



A folding stretcher for the first aid room.

First Aid

★ Two new first aid items have been added to the extensive Mine Safety line. The new items are the **M.S.A. Folding Stretcher Outfit** and **M.S.A. Wood Traction Splint.** The folding stretcher (but 49″ long when folded) is quickly opened to full Army type. Included in the all-weather dust-proof steel case (just 53″ long) are the folding stretcher, a wool and a rubber blanket, four wood splints, two chemical hot pads and a 16-Unit all-weather first aid kit.

The new M.S.A. Wood Traction Splint is designed for use in supporting fractures of the arms or legs according to the accepted traction method prescribed by the American Red Cross. The splint is extensible to 66″ (meeting maximum requirements), and telescopes to a compact size that is easy to pack and carry.

Further information on the M.S.A. Folding Stretcher Outfit and M.S.A. Wood Traction Splint may be secured from Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh.

This splint, though compact, extends to 66 in. in length.

» «

Fire Extinguisher

★ **Pulmosan Safety Equipment Corp.**, Brooklyn, N. Y., has just developed **Magout Powder** to extinguish magnesium fires. This powder is said to instantly smother fires caused by magnesium shavings in machine shops, or by magnesium incendiary bombs. It is a non-absorbent, finely pulverized dry powder, safe to handle and easy to use. Magout is available either in bulk quantities or in handy, instant-action tubes for sprinkling on fire. This is a new type cardboard container, spiral shaped for convenience in handling, with metallic ends and lined with paraffin. Send for free test sample.

Fluxes for Oxy-Acetylene Welding & Brazing

By Houston E. Landis, Jr., and F. C. Saacke

Apparatus Research & Development Dept., Air Reduction Sales Co., Jersey City, N. J.

Reprinted from February, 1942, Issue, Metal Progress

General Flux Characteristics

Phase — Best applied to welding rod as a paste (suspension of powdered salts in water or alcohol). Sometimes applied as a dry powder or injected as a vapor into the welding atmosphere.

Melting Point — Below temperature where an appreciable amount of oxide forms on base metal.

Film — Uniform, quiescent, transparent.

Density — Light and easily floated; no tendency to be trapped in weld metal.

Viscosity at Welding Temperatures — Should be sufficient to keep the weld metal covered and protected from gas absorption and oxidation, but not so viscous as to prevent ready fusion of the welding rod and weld metal.

Oxide Solvent — Should readily dissolve base metal oxides as well as weld metal oxides and keep contact surfaces clean at welding temperatures. (Base metal should practically always be cleaned before welding.)

Weld Appearance — All the above characteristics should combine to permit the rapid deposition of a weld free from oxides, flux inclusions, or gas pockets with smooth, clean surfaces free from overlaps or pits.

Oxy-Acetylene Welding Procedures

Base Metal	Fusion Welding			Brazing		
	Filler Metal	Flame *(a)*	Flux	Filler Metal	Flame *(a)*	Flux
Carbon steel	Low carbon steel	N	None	High zinc brass *(b)*	N to SO	Type C or D
	Low alloy steel	SR	None	Silver alloy	SR to N	Type H
Alloy steel	Similar to base metal	SR	None	Silver alloy	SR to N	Type H
Stainless iron & steel	Similar to base metal *(d)*	N	Type G	Silver alloy	SR to N	Type H
High manganese steel	Similar to base metal	N to SR	None	...	...	...
Cast iron	Similar to base metal	N	Type F	High zinc brass *(b)*	N to SO	Type E
Malleable iron	White cast iron *(c)*	N to R	Type F	High zinc brass *(b)*	N to SO	Type C
Galvanized iron	...	..	..	High zinc brass *(b)*	N to SO	Type C
Nickel	Same as base metal	R	None	Silver alloy	SR to N	Type H
Nickel-copper alloy	Same as base metal	N to SR	Type C	Silver alloy	SR to N	Type H
	Silicon-monel	N to SR	None			
Copper	Deoxidized copper	N	None	High zinc brass *(b)*	N to SO	Type C
				Silver alloy or phos-copper	SR to N	Type H
Silicon bronze	Similar to base metal	N to SO	Type C	High zinc brass *(b)*	N to SO	Type C
				Silver alloy or phos-copper	SR to N	Type H
Red or leaded brass	High zinc brass *(b)*	N	Type C	Silver alloy or phos-copper	SR to N	Type H
Yellow brass	Similar to base metal	O	Type C	Silver alloy or phos-copper	SR to N	Type H
Aluminum (soft)	Same as base metal	SR to N	Type A	Aluminum solder	N or R	None
Aluminum alloy (wrt.)	Same as base metal	SR to N	Type A	Aluminum solder	N or R	None
	Silicon-aluminum alloy	SR to N	Type A	...	...	...
Cast aluminum	Silicon-aluminum alloy	SR to N	Type B	...	...	...
Lead	Same as base metal	N	None	...	...	...

(a)
N—Neutral
O—Oxidizing
R—Reducing
SR—Slightly reducing
SO—Slightly oxidizing

(b) High zinc (38 to 44%) brass with additions of alloying elements such as tin, iron, manganese, silicon, nickel.

(c) Fusion welding of malleable iron should be followed by re-malleableizing heat treatment.

(d) 18-8 stainless steels often alloyed and "stabilized" with columbium, titanium, molybdenum, tungsten.

Specific Flux Characteristics

Aluminum Rod

Type A — An aluminum welding flux composed generally of alkali halides; characterized chiefly by the speed with which solid welds in sheet metal may be made with smooth fusion at the root of the weld and without pitting or discoloration on the surface.

Type B — A modified aluminum welding flux with additions of higher melting point constituents like borates and other chemicals to provide greater slagging action as well as additional viscosity, resistance to oxidation, and protection while making repairs in cast aluminum parts by puddle welding.

Bronze Rod

Type C — An "oxidizing" flux ordinarily made with a boric acid base. It should form a thin but strong oxide film on the surface of the molten copper alloy, thereby preventing gas absorption and excessive oxidation. Recommended for clean or cleaned iron and steel surfaces.

Type D — Where oxidized, rusty, or dirty surfaces are to be joined, an "oxide solvent" flux ordinarily made with a borax base and having a high solvent action for metallic oxides is recommended. It should keep both the base metal and the molten puddle clean and bright. (Note: This flux will not give as good weld metal characteristics as the Type C flux applied to clean surfaces.)

Type E — A "highly oxidizing" brazing flux designed specifically for removing carbon or graphite from the surfaces of cast iron. Usually contains an oxidizing component such as manganese dioxide. (Note: This flux often used with the Type C flux to provide the proper tinning action.)

Cast Iron Rod

Type F — Ordinarily made with a borax base and containing alkali salts to aid in fluxing the slag that forms on cast iron. Should permit ready fusion of the welding rod and base metal without leaving gas pockets or inclusions.

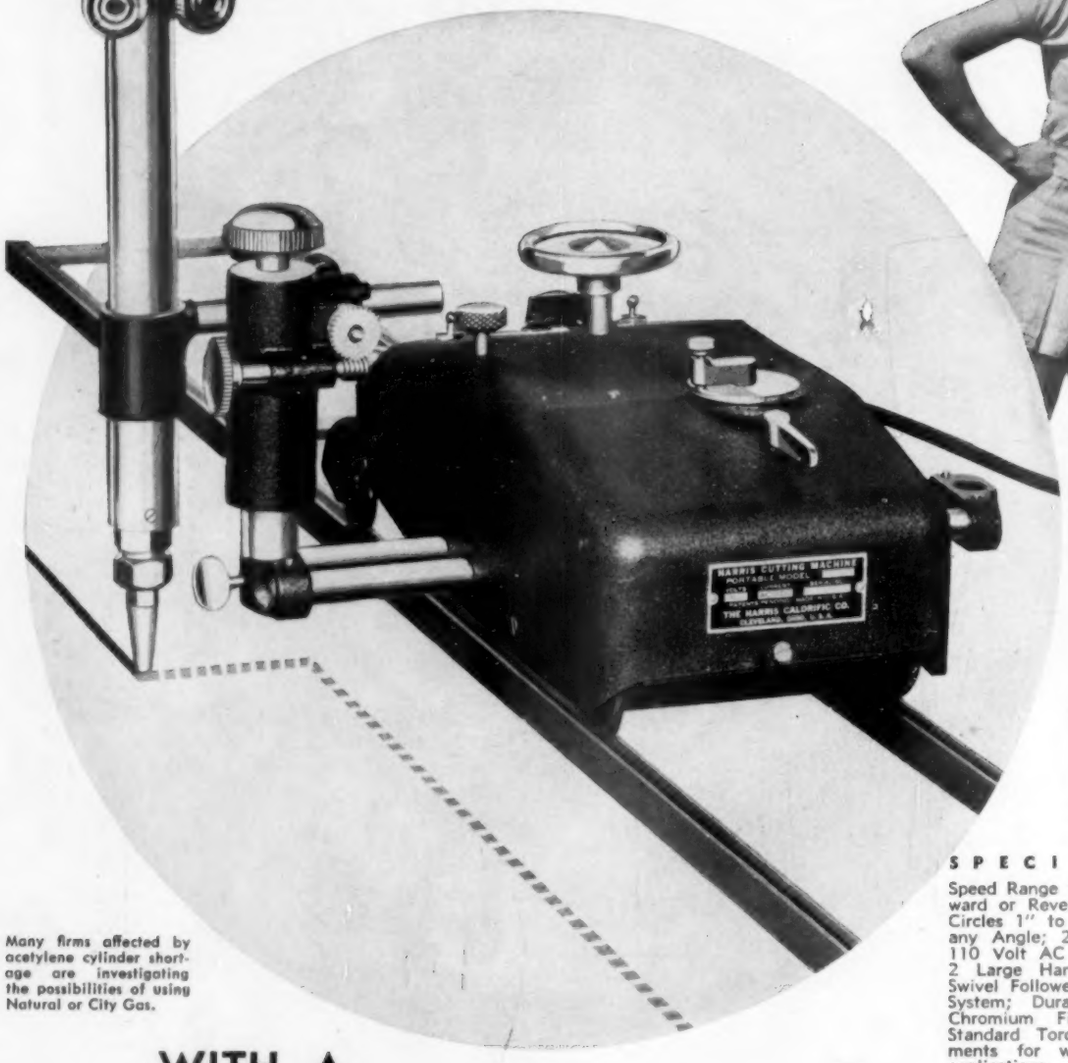
Stainless Steel Rod

Type G — A stainless steel welding flux designed to permit complete fusion at the root of a weld without burning. The best test for a flux of this type is to coat the root of a butt joint with the paste and then observe the penetration at the root after making the weld.

Silver Brazing Alloy

Type H — A silver "soldering" flux made from an alkali bi-fluoride and borax or boric acid; gives the best results on both non-ferrous and ferrous alloys, including stainless.

Clean Cut •



Many firms affected by acetylene cylinder shortage are investigating the possibilities of using Natural or City Gas.

SPECIFICATIONS

Speed Range 3" to 60" per min., Forward or Reverse; Free Wheeling; Cuts Circles 1" to 86" in diameter; Bevels any Angle; 2-Torch Mounting; Motor 110 Volt AC or DC; Weight 45 lbs.; 2 Large Hardened Drive Wheels; 2 Swivel Follower Wheels; 1-Point Oiling System; Durable Black Crackle and Chromium Finish; Cutting Capacity Standard Torch 10"; Special Attachments for wide variety of unusual applications.

WITH A

Harris MODEL "K" CUTTING MACHINE

The Harris Model "K" presents an efficient method of making a ***Clean Cut*** of steel—light or heavy sections. With this equipment Metal Working Shops and Manufacturers can replace costly Castings and Forgings with parts quickly flame-cut from inexpensive and readily accessible steel plate. The Model "K" makes Straight Cuts, Beveled Cuts, Circles and Irregular Shapes. Its versatility enables shops to expand their service and handle work heretofore out of their equipment range. This machine can be equipped with Torches for the use of Acetylene, Propane, Natural Gas and all other combinations with Oxygen. The Model "K" costs less than 1/10 the price of a good Machine Lathe or 1/2 the cost of an ordinary Punch Press Die. Definitely an inexpensive way of opening entirely new fields. Write for folder No. 52-WE.

DISTRIBUTORS IN ALL PRINCIPAL CITIES

The HARRIS CALORIFIC Co.

5501 CASS AVENUE N.W. CLEVELAND, OHIO, U. S. A.

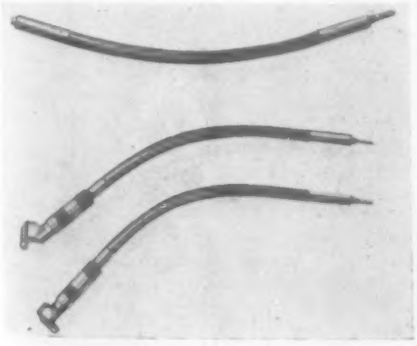
Crater Eliminator

★ The **Mullenbach Electrical Mfg. Co.,** Los Angeles, announce a new crater eliminator known as **Arctrol,** which is suitable for use with practically all standard welding machines.

The Arctrol is a foot-operated, variable resistance unit designed to vary the excitation current of these D-C arc welders. In varying the resistance of the excitation circuit, the output voltage and current of the generator are affected. The Arctrol is designed to regulate the generator output from full-rated current down to snuffing it out completely.

Drill Extensions

★ The **Stow Mfg. Co., Inc.,** Binghamton, N. Y., announces several new **Flexible Shaft Drill Extensions** for use with various flexible shaft machines. These extensions are equipped with 45 and 90 degree angle heads and may also be obtained with a straight spindle. All of the heads are attached permanently to the shaft.



Diameter Chart

Interstate Sales Co., 1123 Broadway, New York, announces a new chart known as **Divizor,** which gives an instant reading of diameter and circumference of any circle up to 72 in. in dia. in steps of ⅛ in. or less. It is also said to give circumference divisions of 1/2, 1/3, 1/4, 1/5, 1/6, 1/7, 1/8, 1/9 and 1/16, the readings all being in fractions of an inch.

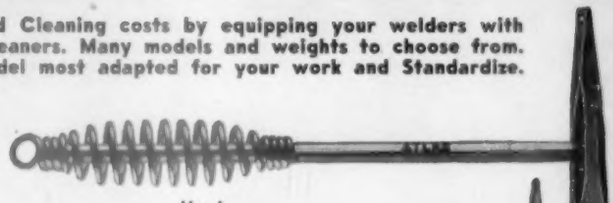
The device provides readings by means of a celluloid pointer revolving on a circle chart. The full circumference is shown on the line directly above the pointer, while the circumference divisions are read along the right hand edge of the pointer below the diameter line.

★ SPATTER PREVENTATIVE — A new product, **Acme Quality Industrial Finish Flash-Off No. 99,** which is designed to eliminate weld spatters and the cost of removing them has been introduced by the Acme White Lead and Color Works, Detroit, Mich. The mechanic simply brushes, sprays, or wipes on Industrial Finish Flash-Off along the edges of the metal surfaces to be joined. Then when the welding is done, metal chips bounce or fall off instead of adhering to areas adjacent to the seam. This eliminates the necessity of grinding or scratching these chips off. An additional feature claimed for the new product is its cleansing effect to the surface to which applied.

The new product will be marketed in 55-gallon drums and 5-gallon cans. Write to **Acme White Lead and Color Works,** Detroit, Mich., Dept. FS-27 for further information.

★ATLAS★

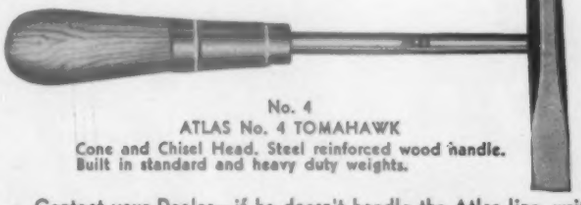
Cut your Weld Cleaning costs by equipping your welders with Atlas Weld Cleaners. Many models and weights to choose from. Select the model most adapted for your work and Standardize. Specify Atlas.



No. 1
ATLAS No. 1 TOMAHAWK
Double Chisel Head. Flex-O type Handle—Built in standard and heavy weights.

No. 2
ATLAS No. 2 TOMAHAWK
Cone and Chisel Head. Flex-O type handle. Built in Standard and Heavy duty weights.

No. 3
ATLAS No. 3 TOMAHAWK
Double Chisel Head. Steel reinforced wood handle. Built in standard and heavy duty weights.



No. 4
ATLAS No. 4 TOMAHAWK
Cone and Chisel Head. Steel reinforced wood handle. Built in standard and heavy duty weights.

WRITE FOR ATLAS FOLDER ILLUSTRATING AND DESCRIBING OTHER MODELS

Contact your Dealer—if he doesn't handle the Atlas line, write direct for the tools you are interested in.

Atlas WELDING ACCESSORIES CO.
307 BOULEVARD BLDG. • DETROIT, MICH.

News of the Industry

Compressed Air Contest

Educational committee of the **Compressed Air Institute,** 45 Warrington Place, East Orange, N. J., has amplified its contest for new ideas on industrial uses of compressed air. Opened as a compressed air contest before Pearl Harbor, it was intended to speed defense. To gain wide dissemination of ideas for greater war production the institute has doubled the cash prizes for ideas, making a total of $1000, and has extended the time for one month, to terminate July 1.

The competition is open to anyone in industry and awards will be on the basis of the ideas submitted, rather than on the form of presentation. Bulletin board posters, describing the contest, are available without charge. Inquiries should be addressed to the educational committee, East Orange, N. J.

» «

The **Arnold Engineering Co.,** engineers and constructors, announce the removal of their offices to 147 East Ontario St., Chicago, Ill.

» «

The Harnischfeger Corp., Milwaukee, Wis., announces the appointment of the following agents for their welding products: **Western Equipment Co.,** Rock Island, Ill., **Motor Accessory & Parts Co.,** Pueblo, Colo., **Welders Supply Co.,** Rockford, Ill., and **Henderson Bros.,** Sacramento, Cal.

» «

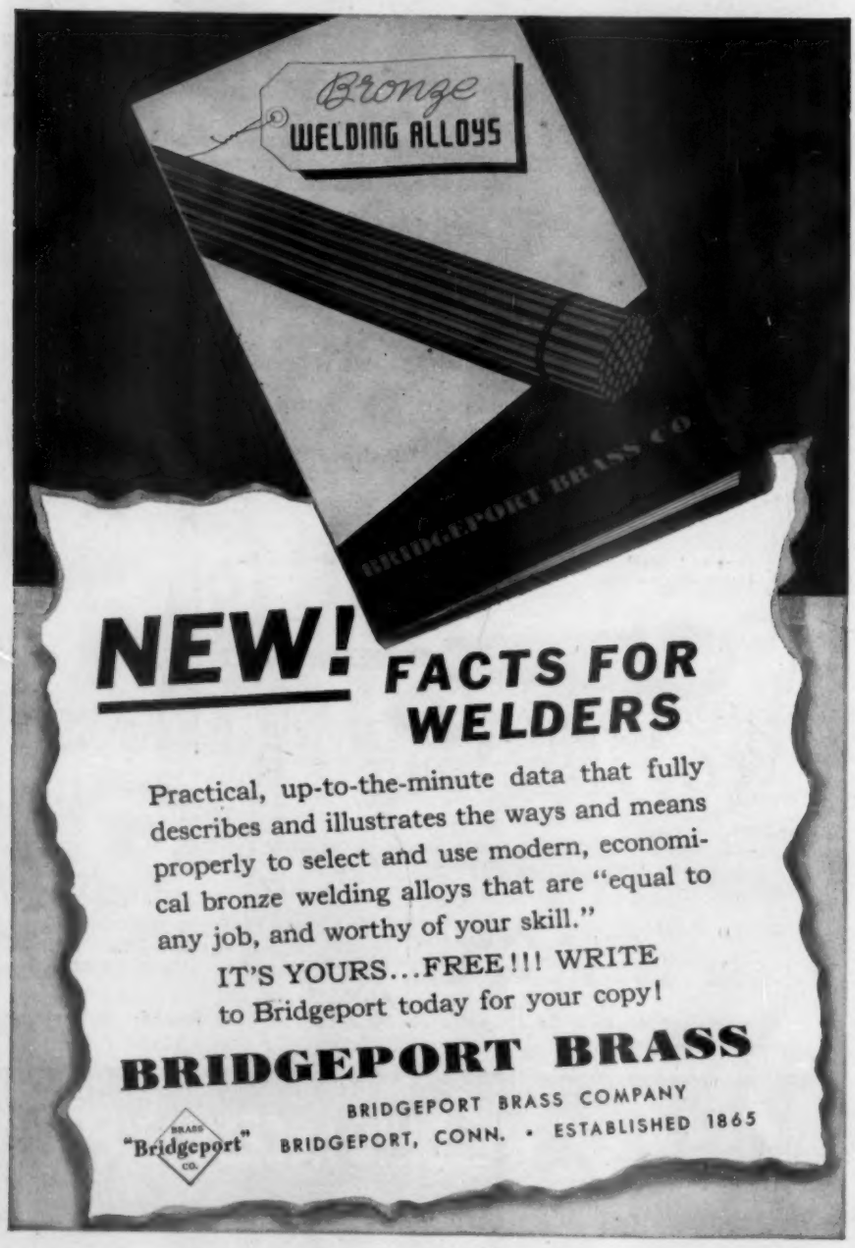
The S-M-S Corp. announce the appointment of **George S. Tivy** as representative of this organization for the Southern California territory. His headquarters are at 1406 S. Grand Ave., Los Angeles.

» «

Tube Turns, Louisville, Ky., manufacturers of welding fittings and forged steel flanges, announce the opening of a branch office in Houston, Tex. This office, located in Room 1707, Commerce Building, will be managed by **W. B. Whenthoff,** formerly in charge of the **Tube Turns** office in Tulsa, Okla.

» «

Tube Turns, Louisville, Ky., announces the appointment of **W. E. (Bill) Geiser** as District Manager of their Philadelphia Office in the Broad Street Station Building. Mr. Geiser has been connected with **Tube Turns,** since 1929.


Bronze
WELDING ALLOYS
BRIDGEPORT BRASS CO
NEW! FACTS FOR WELDERS
Practical, up-to-the-minute data that fully describes and illustrates the ways and means properly to select and use modern, economical bronze welding alloys that are "equal to any job, and worthy of your skill."
IT'S YOURS...FREE!!! WRITE to Bridgeport today for your copy!
BRIDGEPORT BRASS
BRIDGEPORT BRASS COMPANY
"Bridgeport" BRIDGEPORT, CONN. • ESTABLISHED 1865

Personals

K. W. Ostrom has obtained a leave of absence from the Arcos Corp. for the duration and is now in the Welding Section, General Industrial Machinery Division, War Production Board in Washington.

» «

General Electric Industrial Control Division has organized an Electronic Control Section to handle the rapid expansion in the field of industrial electronic controls. **Allen A. Bailey, Jr.,** has been appointed sales manager and will report to **G. R. Prout,** manager of the Industrial Control Division. **William D. Cockrell** will be engineer of the new section and will report to **E. H. Alexander,** who is engineer of the division.

» «

The **Metallizing Co. of America** announce the removal of their Chicago general offices and midwestern warehouse to new and larger quarters at 1330 West Congress St.

» «

A. F. Boucher, Detroit District Manager, Lincoln Electric Co., has been called to active duty in his capacity as a reserve officer. He will be attached with the Ordnance Dept., and for the time being will be stationed with the Detroit Ordnance District.

Boucher's duties as District Manager of the Detroit Office will be assumed by **C. H. Buckmaster** of the co's. Pittsburgh Office, and **J. H. Cunningham** of the Detroit Office will take over Buckmaster's duties at the Pittsburgh Office.

The company simultaneously announces that **George Bain** is being

transferred from the Detroit area to the Saginaw area.

» «

Dr. **Paul Martens** retired as manager of the Metal & Thermit Corp. plant at Carteret, N. J., on April 1, after having completed 33 years of active service.

Prior to his coming to Metal & Thermit in 1909, Dr. Martens was engaged as a laboratory technician in New York City for six years. In 1916 he became superintendent of the plant at Carteret, and in 1919 was made works manager. In these latter capacities he supervised the development of many new processes and improvements in the detinning operations of the company.

In addition to his company responsibilities, Dr. Martens served as director of the Carteret Bank and Trust Co. He is a member of the American Chemical Society and the Electro-Chemical Society.

» «

Henry C. Beal, now manager of the Western Electric Company's Kearny, N. J., Works, became engineer of manufacture on March 1st with offices at the Company's headquarters, 195 Broadway, New York City. He will be succeeded as Works manager by **Reese F. Clifford,** personnel director for the past year. **Arthur B. Goetze,** assistant personnel director, will assume Mr. Clifford's post.

» «

Appointment of **Frank T. Bumbaugh** as assistant manager of sales, alloy division, was announced Feb. 19, by Carnegie-Illinois Steel corporation. Mr. Bumbaugh, who was formerly metallurgical engineer, bar and semi-finished products, in Pittsburgh, will make his headquarters at the company's Chicago offices, 208 S. LaSalle Street.

» «

The appointment of **V. A. Chern,** 15 Gramercy Park South, New York City, as sales and service representative in the New York area and **H. F. Merchant** as sales and service representative in the Philadelphia area, including Eastern Pennsylvania, New Jersey, Delaware, and Maryland has been announced by Progressive Welder Co., Detroit.

Mr. Chern will service South Eastern New York State, including New York City, as well as Connecticut, Rhode Island and Massachusetts in connection with the company's line of resistance welding equipment.

Mr. Merchant has been associated with Progressive Welder Co. since its inception and was formerly with the Chrysler Corp. His experience includes engineering, estimating, design and service activities.

» «

Arthur T. Cox, Jr., has been elected Vice-President of **The Lincoln Electric Railway Sales Co.** with headquarters at Chicago, Ill., according to announcement by C. C. Lanken, President.

Formerly a District Sales Manager in the Industrial Sales Division of The Lincoln Electric Co., Mr. Cox was employed by that concern from September 16, 1936 until May 8, 1939. In his new work, he will be in charge of welder machine and electrode sales as well as engineering service on all Railroads in Chicago and territory west of Chicago.

Mr. Cox, who studied engineering at Cornell and Purdue Universities, was Sales Manager of The Bettendorf Co., Bettendorf, Ia., prior to his appointment to the Chicago post. He was graduated from Purdue in 1933.

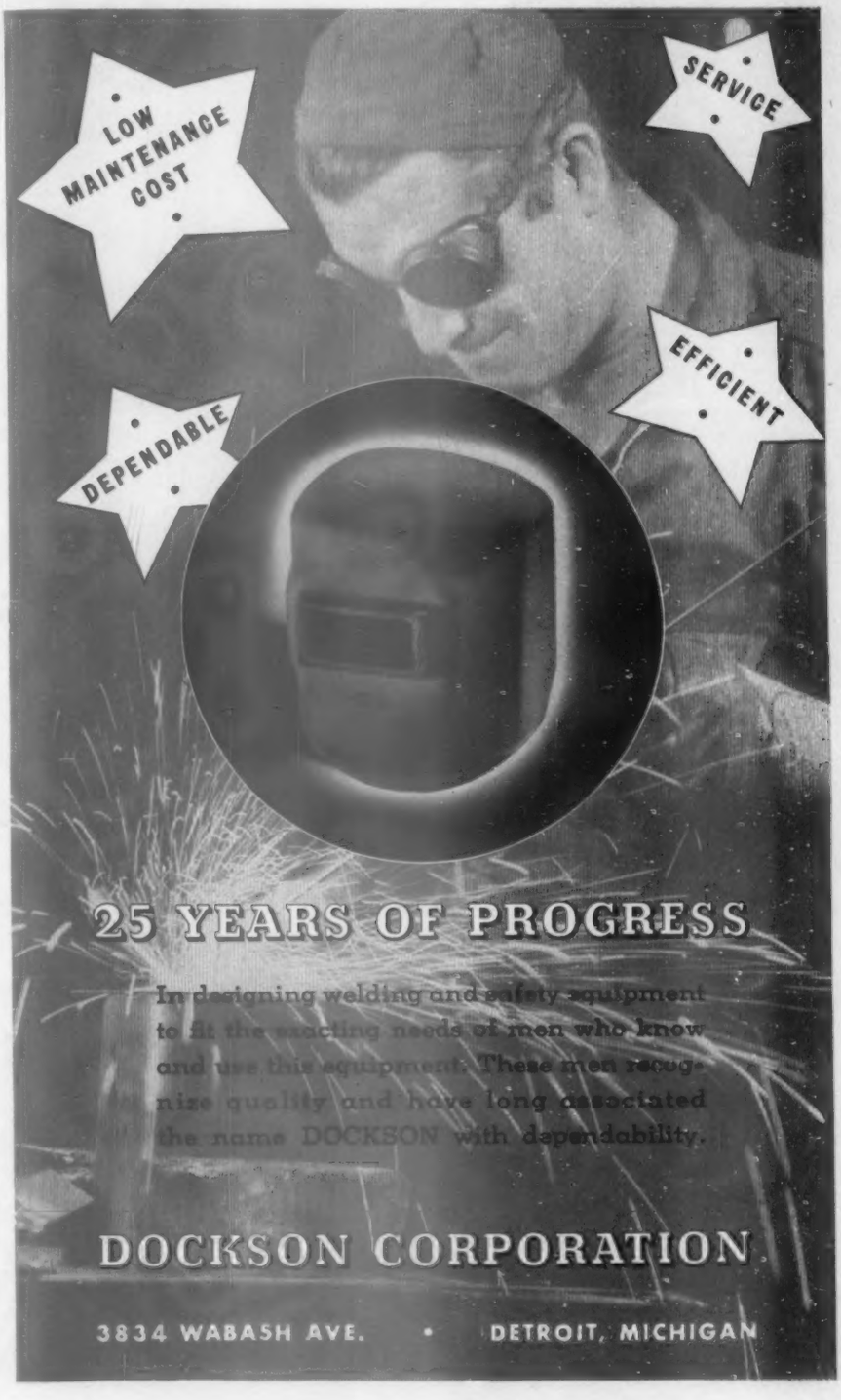
» «

T. F. Barton, New York and **W. B. Clayton,** Dallas, Texas, have been elected commercial vice presidents of the **General Electric Co.** Both have been district managers in their respective territories and will continue as such.

Mr. Barton, a native of Orangeburg, S. C., entered the employ of General Electric in 1906. He became district engineer of the New York territory in 1927, was appointed assistant manager of the district in 1939, and manager on January 1, 1941. He has twice won the Charles A. Coffin Foundation award, highest honor which General Electric bestows upon its employees.

Mr. Clayton, a native of Brooklyn, N. Y., joined General Electric as a student

(Continued on page 63)


LOW MAINTENANCE COST
SERVICE
EFFICIENT
DEPENDABLE
25 YEARS OF PROGRESS
In designing welding and safety equipment to fit the exacting needs of men who know and use this equipment. These men recognize quality and have long associated the name DOCKSON with dependability.
DOCKSON CORPORATION
3834 WABASH AVE. • DETROIT, MICHIGAN

ONE *Hard-Facing* JOB NOW

May Eliminate a Dozen Maintenance Jobs Later!

The best way to prevent shutdowns and eliminate costly parts replacement is to protect all wearing surfaces with Stoody Hard-Facing Alloys. Almost *any* part subject to abrasive or frictional wear can be kept in service *longer*—at *less* maintenance expense!

In most cases, operators obtain best results by hard-facing new parts *before* they are placed in service . . . then re-hardfacing as the needs arise. However, worn equipment can easily be reclaimed and put back in service by a simple rebuilding method. *Most important:* overall cost, in either case, is usually but a fraction of new part cost, yet hard-faced parts give as much as ten times more service. Stoody Hard-Facing Alloys are supplied as welding rods, in types and diameters for all applications. They can be used with either standard electric or oxy-acetylene welding equipment.

Here are typical examples of how Stoody Alloys are being used in industry to cut replacements, eliminate shutdowns:

CONSTRUCTION: A steel tractor roller hard-faced with Coated Stoody Self-Hardening will outlast two new, unprotected rollers. Expense of rebuilding and hard-facing is about 1/3 of new roller cost.

AIRCRAFT: Ordinary hardened alloy steel thread gauges used in an aircraft plant were unfit for further service after only 4 hours. But threads ground in a deposit of 3/16" Stoodite "45", applied on the periphery of a cold rolled steel mandrel, have so far given 60 days continuous gauging service in this same plant . . . an increase in gauge life of 36,000%.

BRICK AND CLAY: Pug mill knives are subject to severe abrasion in the wet clay mix, and normally have but a short life. The unprotected knife shown at top was worn out after three months service. But the knife below, hard-faced with Borod, has seen **7 months** of almost continuous service and is still as long and as wide as the day it was put in use.

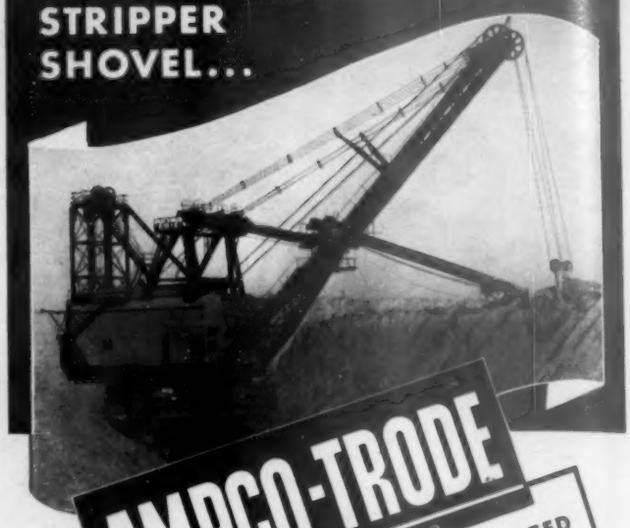
We'll gladly send descriptive literature, or recommend the proper Stoody Alloy and welding procedure for your conditions. Write now!

STOODY COMPANY

1134 WEST SLAUSON AVENUE, WHITTIER, CALIFORNIA

STOODY COMPANY *Hard Facing Alloys*

In the World's Largest STRIPPER SHOVEL...



AMPCO-TRODE

THE *Only* COATED ALUMINUM BRONZE WELDING ROD

The four huge leveling pistons in the Bucyrus-Erie 1050 stripping shovel—the largest yet produced—have, in the machine illustrated, an overlay of Ampco-Trode coated aluminum bronze welding rod.

Since the pistons work automatically—keeping the 2,800,000 pound machine level at all times — the bearing qualities of the weld overlay are of great importance.

The bronze weldrod is made of Ampco Metal, outstanding as an alloy with excellent bearing characteristics that can take hard punishment and like it. These qualities are inherent in Ampco-Trode electrodes.

Grade 18 Ampco-Trode rod was best adapted for the Bucyrus-Erie application. This is one of the seven grades of Ampco-Trode weldrod. The series have a range of tensile strength of 50-80,000 p.s.i. Hardness is 100 to 375 Brinell. Rods are made in six sizes—1/8" to 1/2" diameter. Suitable for welding by metallic arc, carbon arc or oxy-acetylene methods.

FREE BULLETIN

Ask for latest Ampco-Trode Bulletin describing these bronze welding rods and giving welding technique and instruction. Sent free on request.

AMPCO METAL, INC.

Dept. WR-5 Milwaukee, Wisconsin

AMPCO-TRODE
A product of
AMPCO METAL
The Metal Without An Equal
AMPCO

Personals

(Continued from page 61)

engineer. In 1924, when the Southwest district was organized with Dallas as headquarters, Mr. Clayton was named manager of the Central Station Department and assistant manager of the district. In November, 1939, he was elevated to the post of district manager.

» «

The election of four new Assistant Comptrollers of the **General Electric Co.** has been announced by President Charles E. Wilson. They are **A. B. Crouch, D. L. Millham** and **G. S. Hyatt,** of Schenectady, and **C. E. Anderson** of Bridgeport, Conn.

Mr. Crouch, a native of Detroit, entered the employ of General Electric in 1926 under the Company's Business Training Program and began work in the Accounting Department at Schenectady. In 1930, he became one of the Company's traveling auditors, and three years later was again assigned to work in the General Accounting Department at Schenectady as Auditor of Corporate Accounts. In 1939 he was appointed Assistant to Comptroller.

Mr. Millham was born in Scotia, N.Y., in 1927 he joined General Electric's accounting organization at Schenectady under the Company's Business Training Program. Three years later he was added to the staff of traveling auditors on which he served until 1935, when he became General Electric's Tax Accountant.

A native of Lincoln, Nebr., Mr. Hyatt, in 1923, became affiliated with the Accounting Department at Schenectady under the Business Training Program. In 1932, after several years' experience in various divisions of the Company, Mr. Hyatt was appointed Auditor of the Plastics Department at Pittsfield, Mass., where he remained until 1934 when he returned to Schenectady and shortly thereafter was appointed Auditor of Works Accounts.

Mr. Anderson, born in Gloucester, Mass., joined the Company's organization at Schenectady in the Business Training Program in 1924. In 1932, after various assignments throughout the Accounting Department, Mr. Anderson was appointed Auditor of Disbursements at Schenectady. In January, 1936, he was transferred to Bridgeport as Auditor of the Company's Appliance and Merchandise Department.

Obituary

Fred J. Maeurer, Air Reduction Sales Co., died suddenly on April 13. Mr. Maeurer became associated with the oxy-acetylene industry on Nov. 1, 1909, when he joined the forces of the Davis-Bournonville Co., Jersey City; his record of service with Airco dates from March 17, 1922, the date of the acquisition of the DB Company by Airco. His service record of nearly 33 yrs. in the industry covered a wide variety of activities. In the early days he was superintendent of the DB Welding Shop at Jersey City, and for a number of years was located in Chicago in the capacity of a service engineer. For the past thirteen years he had been associated with the Applied Engineering Department as a specialist. He had a broad knowledge of the practical applications of oxy-acetylene welding and cutting, and had made many friends throughout our organization and industry. The industry has lost one of its pioneers.

» «

Buy

WAR BONDS

to avoid

BONDAGE

Future of Welding

(Continued from page 50)

without causing leakage, whereas in the case of riveted construction, the seams are frequently ripped open, usually causing complete loss of the vessel." Also, this statement is recorded as made by David Arnott, vice-president and chief surveyor of the American Bureau of Shipping, New York: "Welding will eventually supplant riveting entirely. This might take quite some time but welding has made tremendous progress during the past ten years."

Welding in Manufacture

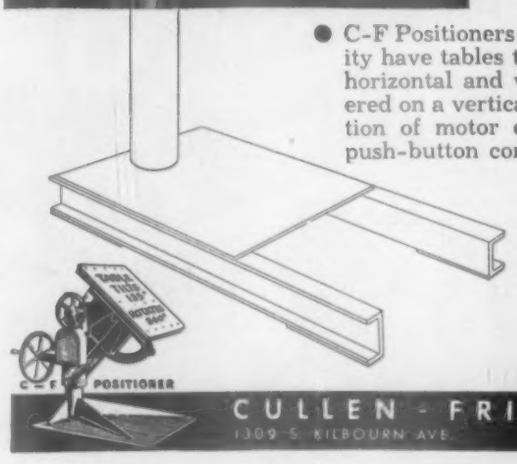
Another greater application for this process is in the manufacture of machinery and parts previously made by iron and steel castings. This is

(Continued on page 65)

welds "down-hand" on C-F POSITIONERS

- Welding motor frames for 100 or 125 ton Westinghouse Diesel Electric Locomotives is the job being done on the Cullen-Friestedt Positioner shown in this photograph. It demonstrates how simple and easy it is to handle a heavy, awkward weldment besides doing a *better* job of welding, *faster.* Throughout industry geared to the speed that the war demands, C-F Positioners are saving man-hours on the production line; are handling heavy parts with greater safety; are speeding up the building of machines for victory.

- C-F Positioners from 1200 to 14000 lbs. capacity have tables that rotate 360°, tilt 135° from horizontal and which may be raised or lowered on a vertical column. They have a variation of motor operating arrangements with push-button control.



Write today for our descriptive circular WP-20 giving facts and figures.

CULLEN - FRIESTEDT CO.
1309 S. KILBOURN AVE. CHICAGO, ILLINOIS

Ideal FOR AIRCRAFT WELDING
TWECO "HOL-GRIP JR."

Small ← actual size

Light Weight only 8 ounces

Strong

For Aircraft ...and ALL other Light Gauge Welding

STEP UP PRODUCTION . . . ELIMINATE OPERATOR FATIGUE

The Aircraft Industry is really taking to this strong little holder. Above is its actual size. It's fully insulated; 7 inches long; 150 amperes capacity; takes electrodes through 5/32 in.

TWECO PRODUCTS

Tweco "HOL-GRIP JR" makes close quarter work on all light gauge metals a lot easier. It takes a positive grip on the electrode at any desired angle. Work spoilage through accidental arcing is cut to a minimum. All Conductor parts are 98% Copper Alloy and the spring is insulated against burnout.

Convert Heavy Duty Holders for Light Work

Take heavy duty and light work as it comes . . . the easy way. Heavy duty holders can be converted quickly to light work with combination "Hol-Grip Jr" and Whip End Cable attachment. Cable has a connection lug that clamps right into regular heavy duty holders. On completion of light work, the whip cable and "Hol-Grip Jr" can be quickly detached. Get this combination today for versatile operation.

Write for Literature
See Your Distributor

TWECO PRODUCTS COMPANY
ENGLISH AT IDA — WICHITA, KANSAS

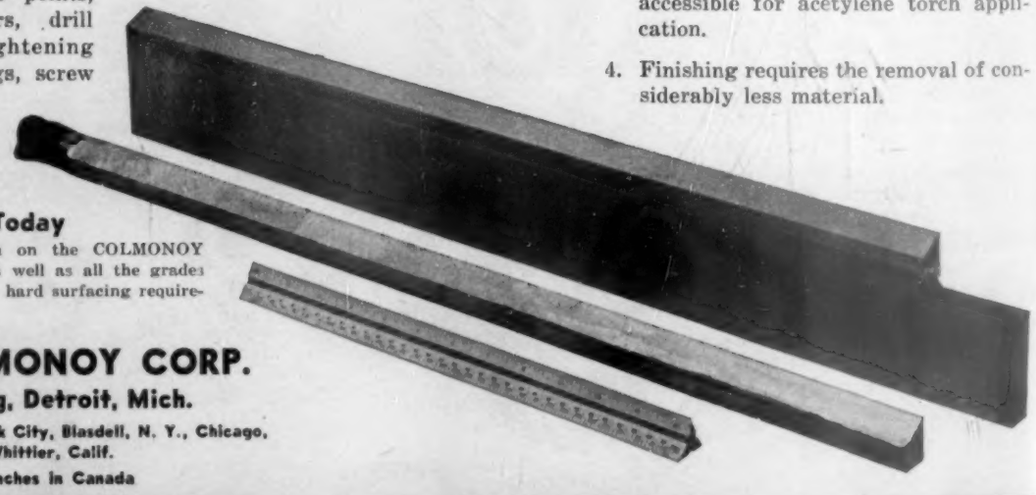
COLMONOY FURNACE WELDING

This process consists of applying a casting of COLMONOY No. 6 hard-surfacing alloy to steel base parts that are subject to corrosion, abrasion, wear and galling. Some of the advantages of this process are:

SAVES VALUABLE TIME

1. It is adaptable to high production parts.
2. There is complete freedom from porosity and cracks.
3. Parts can be hard-faced which are inaccessible for acetylene torch application.
4. Finishing requires the removal of considerably less material.

Use COLMONOY No. 6 on parts subject to great wear and abrasion — lathe points, dogs, chip breakers, drill flutes, wire straightening shoes, thrust bearings, screw machine fingers, forming and drawing edges, etc.



Write Today

Ask for full information on the COLMONOY Furnace Weld Process, as well as all the grades of COLMONOY for every hard surfacing requirement.

WALL-COLMONOY CORP.
Buhl Building, Detroit, Mich.

Branch Offices at New York City, Blasdell, N. Y., Chicago, Tulsa, Whittier, Calif.

Other Branches in Canada

Future of Welding

(Continued from page 63)

the greatest field for welding and offers the greatest scope for the engineer. Many thousands of tons of cast iron construction have already been changed to welded steel. How arc welding develops in this application depends on how cleverly the design is made to take advantage of this process. The possibilities are great. Structural steel is two and one-half times stiffer than cast iron. This means that if a structure depends on stiffness for its success, as in supporting frames, only 40 per cent as much steel is necessary, as would be the case with cast iron. Structural steel is four times as strong as cast iron. If the structure depends on tensile strength for its success, such as a boiler, one quarter as much steel will be required. In addition to this —structural steel is, on the average, one-half as costly per pound as cast iron in the form of castings. These facts are true only for a comparison of the cost of unformed structural steel with that of a completed casting. The final cost of the structural weld will depend on how well arc welding is applied to the new design. This does not necessarily mean that all castings will be substituted with steel. In cases where the casting is the thing to use, it should be used.

Design for arc welding is important. The economies possible by this process cannot be obtained unless the design lends itself to welding. Too many designs are not actually made for welding. In such cases the advantages of welding cannot be obtained. If the design is correct in both cost and material, the finished product will be correct.

Electrodes and Current

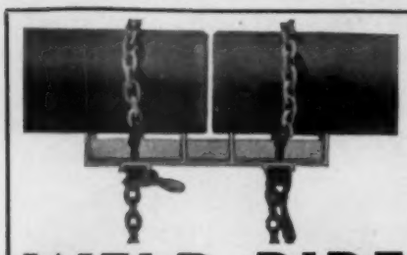
There are many aspects to welding procedure that are often neglected or not realized. To get the maximum results out of this process, we should first use large electrodes; secondly, use high current values, and thirdly, increase operator factor. By using large electrodes it is possible to deposit more metal, and the cost of the deposited metal is considerably less. For example, the pounds of metal deposited per hour can be increased by 20 per cent by changing from $\frac{3}{16}$ in. to $\frac{1}{4}$ in. electrode. There are other advantages in using larger electrodes, resulting in lower final cost. In addition to the increased deposition rate, the tendency towards distortion is reduced with fewer number of passes; the higher current values improve the quality of the weld metal.

The rate at which the electrode melts varies almost directly with the amount of current used. To get the highest welding speeds, it is necessary to use increased currents, thus increasing the deposition rate. There seems to be some doubt as to whether higher welding currents are advisable. In some cases it is conservatism, in others it is prejudice. This misconception can be proven by conducting a simple experiment with a $\frac{3}{16}$ in. diameter electrode and welding one electrode with 150 amperes, another with 200 amperes, and still another at 250 amperes. The difference in welding speed will be very convincing. In addition to increased welding speeds due to higher current, it requires less concentration on the part of the operator, also gives smoother appearance of welds due to greater fluidity of the weld metal, better penetration, and better quality weld metal due to slower cooling rate.

The Factor of Time

The operator factor or the per cent of time the arc is in operation gives the greatest cost reduction, and is exceedingly important. For example, if the arc is in operation 20 per cent of the time, and assuming the welding speed is 10 ft. per hour, and the operating factor were increased to 40 per cent the welding speed would be doubled and the cost per foot of weld would be reduced in almost equal proportion. To increase operating factor does not require more effort or more difficult work. It is

WE DID IT IN 1917-WE ARE DOING IT AGAIN Today
THE Alexander Milburn Company has been serving Government and Industry for over forty years. Milburn cutting, welding and spray finishing equipment saw "action" in World War I and is again today widely used in all phases of our defense activities . . . in aviation, shipbuilding, transportation, and industry. Equipment by Milburn may be relied upon for superior service under pressure of today's demands for "all out" Defense. Write for complete catalog.
The ALEXANDER MILBURN Company
1403 W. BALTIMORE STREET · BALTIMORE · MD.



WELD PIPE
Faster . . . Easier . . . Truer
WITH
***JEWEL* PIPE CLAMPS**

Weld more pipe in a day with Jewel Pipe Clamps. They keep the welder welding instead of waiting, for it only takes a minute to put them on and set the pipe in perfect alignment.

There is a Jewel Clamp to meet every layout condition — Jewel Pipe Clamp for straight-away work. Jewel Tube Turn Clamp. Jewel Welding Flange Clamp. Jewel Angle Clamp. All are rigidly constructed to resist strain, heat and abuse. All help cut erection costs.

Write Today for Circular Giving Complete Details

JEWEL Manufacturing Company
1841 University Ave.
ST. PAUL, MINNESOTA

Future of Welding

(Concluded from page 65)

mostly a matter of procedure. The operating factor can be increased by placing work in position, so that the operator can weld in the downhand position. This will permit the use of larger electrodes and higher currents. In a ½ in. fillet weld, the welding speed would be about 11 ft. per hour (arc time) and if the same structure were positioned would require an hour (arc time) to complete 26 feet. This advantage is the result of the fact that a ½ in. weld not positioned would require three passes, whereas the positioned work would require one pass with a larger electrode and more current. Jigs and fixtures are also important in increasing the operator factor. This does not mean elaborate design and construction. A simple structure that will assist in the assembling of a product to be welded is all that is required. Other aspects of procedure such as proper fit-up of joints to be welded, proper selection of the type of joint, using modern welding equipment, also minimize welding costs.

Advancement in Welding

Many men are interested in advancement in the field of welding but in most cases do not know the course to follow to get training. Technical knowledge can be obtained by taking a good engineering course in arc welding. There are several schools giving this type of course, consisting of four years' of training, and a degree in welding engineering. Several years of practical experience in addition to the technical training gives one a good foundation for further advancement. However, this type of course is not within reach of most men. There are a number of good correspondence courses in which a welder can get a good foundation in engineering fundamentals. These schools give courses that include design, metallurgy, blueprint reading, strength of metal, etc.

In view of the present difficult conditions requiring long hours and hard work, this method of obtaining training requires much will power and perseverance. A more practical way to get this technical training is by individual or group study. There are a number of good handbooks on the subject of welding, including welding metallurgy, blueprint reading, strength of materials, and other phases of engineering. Through group study, with a capable person as instructor, this training can be obtained without much difficulty. Discussion groups are formed where ideas and experiences can be transmitted. In addition, there is up-to-date information on welding available through the medium of good trade journals covering the welding field. Individual experimenting gives one new ideas and much can be learned this way. Manufacturers of welding equipment, who are continually doing research, release data and information that in most cases is very useful to the field of welding.

Try to determine through your daily work the "WHY" of the things you do and see whether it can be done better. Try to get the answers for doing things in a certain way and perhaps with your ingenuity you can do better. In view of the present emergency, the demand for welding operators is greater than ever before.

The welding industry is going to continue to develop. The demand for men experienced in the field will continue to grow because welding is very much in its infancy. However, this development will not grow, or at least will not grow rapidly without some definite plan. It will be necessary to continue with the economies that welding offers. THE END

INVESTIGATE THE NEW
ISOROD SELF-HARDENING FORGEABLE
ALLOY ELECTRODE

FEATURES of deposited metal—

BRINELL 520 to 560 Rockwell 52-56 TENSILE STRENGTH above 180,000 P.S.I.
LOW SPATTER LOSS—less than 10% including flux
APPLICATION—to all irons and steels including stainless
DEPOSITS—truly forgeable without checking or loss of hardness

USES—for armoring all rock handling and dredging equipment such as shovel teeth, tractor treads, centrifugal pumps, crushing mantles, guide and thrust rollers, sprocket gears.

PRICES AND SIZES—

¼" dia. x 14" long end grip electrodes....50c lb. 5/32" dia. x 14" long end grip electrodes....58c lb.
3/16" dia. x 14" long end grip electrodes....50c lb. ⅛" dia. x 14" long center grip electrodes....65c lb.
3/32" dia. x 14" long center grip electrodes..75c lb.

AND FOR HEAVY DUTY SERVICE USE

RESISTO-LOY

Resisto-Loy hardfacing is an extreme duty rod, deposits of which must withstand severe abrasion and heavy impact without chipping. Try it on your next hardfacing job.

TRADE-MARK REGISTERED

PRICED FROM $1.50 PER LB. 5/16" DIA.

WAREHOUSE DISTRIBUTORS

BIG THREE WELDING EQUIP. CO.
Fort Worth, Houston, San Antonio, Texas, and Tulsa, Oklahoma
WOODWARD, WIGHT CO., LTD.
New Orleans, La.
CORPUS CHRISTI OXYGEN CO.
Corpus Christi, Texas
PURITAN COMPRESSED GAS CORP.
Kansas City, Mo.
PURITY CYLINDER GASES, INC.
Grand Rapids, Kalamazoo, Lansing, Michigan
SOUTHERN OXYGEN CO.
Arlington, Va., Baltimore, Md., Kingsport, Tenn.
J. E. DILWORTH CO.
Memphis, Tenn.
WELDING METALS MFG. CO.
Detroit, Mich.

RESISTO-LOY COMPANY GRAND RAPIDS MICHIGAN

★ ★ ★ ★ ★ ★ ★
Buy More War Bonds
★ ★ ★ ★ ★ ★ ★

(Trade Mark Registered)

Doubly-Deoxidized Welding Alloys:

PENN BRONZE

TITAN BRONZE

TITAN MANGANESE BRONZE

Specify *Titan* Welding Alloys

TO ASSURE UNIFORMLY SOUND, STRONG, DUCTILE BRONZE WELDS

Doubly-Deoxidized PENN BRONZE, TITAN BRONZE and TITAN MANGANESE BRONZE Welding Rods have proved their definitely superior welding qualities over a period of many years and under the most exacting requirements.

The Double-Deoxidization process, developed by Titan engineers, definitely increases the ductility of the weld metal, reduces fuming to a minimum and assures a sound, dense, strong weld.

Descriptive literature sent upon request

TITAN METAL MANUFACTURING CO., BELLEFONTE, PA.

TITAN WELDING RODS

DON'T GET A DUD WELD

SAVE YOUR WELDS

BY USING

No. 1 FLUX-WELL FLUX

For All Cast Iron and Cast Ferrous Alloy Metals

•

The Chicago Hardware Foundry Co.
542 Engineering Building
NORTH CHICAGO, ILLINOIS

SPEEDING up production through use of simple jig which holds tubular framework during welding operation.

DE-STA-CO *Toggle* CLAMPS assure quick, positive clamping and easy, instant release. When you design fixtures for holding parts during welding, machining, reaming, inspection, drilling, assembly or similar operations always specify De-Sta-Co Toggle Clamps . . . built in all sizes from the small 9¼ ounce aircraft model up . . . every clamp carefully engineered to assure ease of operation without undue looseness.

Bulletin No. 41 illustrates many uses . . . sent free, on request.

DETROIT STAMPING CO.
Established Over 25 Years
372 Midland Ave • Detroit, Mich.

Current Reviews

Metallizing Bulletin

16-page Bulletin 42A, published by Metallizing Engineering Co., Inc., Long Island City, N. Y., tells briefly how essential industries are eliminating replacements, and increasing service-life of equipment by building up worn diameters with any desired wear, and corrosion-resistant sprayed metal. Also how metallizing is used to salvage mismachined parts and defective castings in production. Examples given to show how metallized "inserts" and coatings are helping manufacturers conserve vital metals.

» «

Executive Information

The **National Foremen's Institute, Inc.**, Deep River, Conn., announces the publication of two pamphlets of interest to executive personnel. The first of these, **"A Confidential Report on Collective Bargaining,"** discusses the present need for bargaining and gives many valuable pointers on the kind of bargaining that avoids trouble and saves money. This report, which was prepared by the staff of Executive's Labor Letter, is priced at $1.00.

The second pamphlet, entitled **"The Self-Rating Scale for Leadership Qualifications,"** is a 2-page folder which, through a series of 20 questions, enables one to determine their ability to handle subordinates as well as handle themselves. This is a practical and helpful executive evaluating system which has been prepared by Eugene J. Benge and is priced at 25 cents.

» «

Revised Boiler Code

The boiler code committee of the **American Society of Mechanical Engineers**, 29 W. 39th St., New York, recently released a completed preliminary draft of the proposed revision of section VIII of the **boiler construction code** for general distribution and critical review, in order to expedite the work as much as possible.

Comments are invited from all interested parties, with the request that they be received by the secretary of the boiler code committee not later than July 1, 1942.

Copies of the draft may be obtained from the society's headquarters at $1 per copy.

» «

Building Code

The American Institute of Steel Construction has issued a **"Specification for the Design, Fabrication and Erection of Structural Steel for Buildings by Arc and Gas Welding (Tentative)."** This specification has been made as comparable and as similar as possible to the AISC Specification for Riveted Construction which has been used widely for many years and which covers the use of riveted, bolted and pinned connections.

This specification has been prepared in conjunction with the AWS code, and it is expected that when these two documents have maintained the status of full adoption rather than a tentative status, the specification will augment the code so as to provide a complete document covering all phases of design, fabrication and erection of structural steel for buildings by arc or gas welding.

» «

Brazing Bulletin

"Low Temperature Welding" is the title of a new 4-page bulletin released by **Eutectic Welding Alloys, Inc.**, New York City. This bulletin describes the various low temperature welding rods produced by this organization. In addition to giving various metallurgical characteristics, information is also given as to the type of rod to be used for the repairing and fabricating of various metals and the melting temperatures at which binding is started.

» «

How to Tackle War Business

Here, in our opinion, is the "real book of the month"—**How One Company Tackles the War Production Problem.**

This is an actual case history of how one American manufacturing concern, faced with the loss of more than half of its business, planned and executed that plan to obtain prime contracts and sub-contracts, in order to keep the business going.

The manufacturer involved in this case study was prevailed upon by manufacturing friends to publish this story as a guide which would be helpful to other manufacturers.

The book is a step by step treatment of how this company set about to regain lost production—replacing former peace time products with war products.

(Continued on page 70)

A YEAR'S DELAY SAVED BY BRONZE WELDING!

Fractured spokes of 24 ft. flywheel repair welded with Anaconda 997 Low-Fuming Bronze Rod in 56 man hours

When two spokes of this giant flywheel were broken, it appeared as though a blast furnace with essential war production might be out of operation for a long time.

The Hebeler Welding Company, Buffalo, was called in as soon as it was learned that a new wheel probably could not be delivered for a full year.

In just 56 man hours, the Hebeler men completed the job with about 300 pounds of Anaconda 997 Low-Fuming Welding Rod. An insurance company then insured the repaired wheel, which once again proves the statement that good workmanship plus a good material equals dollars—and time—saved! 41137

ANACONDA *Anaconda Welding Rods*

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

It's a Great Life . . .

When You Weaken!

Join THE AMERICAN WELDING SOCIETY

If Ralph Waldo Emerson's famous inventor of the better mousetrap had lived today, he'd undoubtedly have welded it.

But if he had been the hermit of Emerson's fable, and hadn't attended Section Meetings of The American Welding Society . . . chances are, his mousetrap would have been so obsolete that no self-respecting mouse would have even sniffed at it.

Today, we Americans are building deadly "mousetraps" for the enemy . . . and welding the planes, tanks, ships, shells and other munitions that defend us and our Allies. We need every bit of technical help available.

That's why engineers, purchasing agents, industrial executives, draftsmen, foremen, welders, research workers, professors, students . . . the Men of Industry, present and future . . . have flocked to join The American Welding Society.

Here's what the Society and its 4800 members offer you in 1942:

1. **An opportunity to meet and talk with leaders of the welding industry at monthly Section meetings, and at other regional and national meetings.**
2. **A key to new ideas and the latest progress in the art. Code service for Sustaining Members, with up-to-date bulletins.**
3. **A chance to take an active part in developing better welding techniques and new applications. Research conducted under the auspices of the Welding Research Committee.**
4. **Membership Certificate; Membership Emblem (available at nominal cost).**
5. ***Year Book* telling "who's who" in welding.**

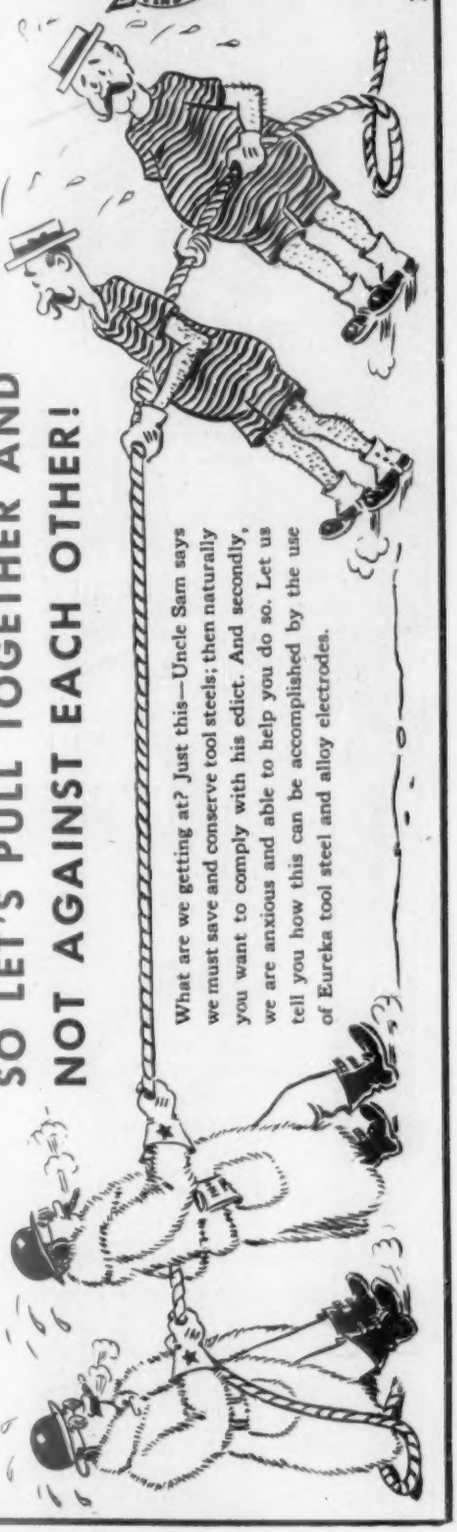
COST: Sustaining Membership, $100; Membership, $15; Associate Membership, $10; Operating Membership, $5; Student Memberships, $2.50 a year.

The American Welding Society provides you who are interested in welding with a growing fund of data and ideas . . . any one of which may be worth many times the cost of many years' membership to you. Please write me for a free copy of our informative booklet on the Society.

J. D. TEBBEN, Chairman Membership Committee

THE AMERICAN WELDING SOCIETY
33 West Thirty-Ninth Street
New York, N. Y.

A TUG OF WAR IS ALRIGHT AT A PICNIC . . .
BUT BROTHER THIS WAR IS NO PICNIC—
SO LET'S PULL TOGETHER AND
NOT AGAINST EACH OTHER!


SAVE! CONSERVE!
What are we getting at? Just this—Uncle Sam says we must save and conserve tool steels; then naturally you want to comply with his edict. And secondly, we are anxious and able to help you do so. Let us tell you how this can be accomplished by the use of Eureka tool steel and alloy electrodes.

WELDING
EQUIPMENT
SUPPLY CO.
221 LEIB ST.
DETROIT MICHIGAN

99.9+% PURE
TUNGSTEN ELECTRODES

Metallurgically Correct for Atomic Hydrogen Welding

The success and economy of atomic hydrogen welding depends greatly upon the quality of the tungsten electrodes which sustain the arc.

You can now obtain electrodes of chemically pure tungsten, uniform in physical structure, slow burning under the intense heat of the arc. They are straight, clean, true in diameter, all of which helps sustain an even, non-sputtering arc with controlled temperature at the weld.

Write today for Bulletin W-421. This bulletin contains full information and specifications on tungsten electrodes of unexcelled quality.

Prompt Deliveries on All Standard Electrodes

4237

VASCOLOY-RAMET CORPORATION
Sole Distributor
NORTH CHICAGO, ILLINOIS
DISTRICT OFFICES IN PRINCIPAL CITIES

Current Reviews

(Continued from page 68)

Most interesting is the completeness of their campaign in going after sub-contracts; the job within their own organization to co-ordinate all divisions of the business to expedite this work.

The fourth and final step in this book —"Coordinated Action," is packed with suggestions for every manufacturer, large or small. It deals particularly with the company's own War Production Board—a committee that meets every day to coordinate all divisions of the business on this one all-important problem of identifying the company with the war picture. The operation of this war committee is outlined in detail.

A copy of this book may be obtained at no charge by writing on your business stationery to **Lyon Metal Product[illegible]nc.**, 542 Clark St., Aurora, Ill.

» «

Personnel Morale

A manual for business executives and plant managers on **"How to Boost Production Through Increased Employee Morale"** has just been issued by the Labor Relations Institute. The pamphlet details practical methods for organizing management-labor committees as a means of obtaining greater output.

It tells also how to formulate and administer suggestion systems and effective grievance machinery, and it includes practical pointers on how to enlist union and employee cooperation in plans for speeding production. Discussed, too, are effective uses of posters, bulletin boards, loudspeaker systems and production scoreboards. In addition, the booklet provides a check-list of fifteen industrial "morale killers" which retard production and lower employee morale.

This manual may be obtained by writing to: Lawrence Stessin, Chief—Industrial Division, **Labor Relations Institute**, 1775 Broadway, New York.

» «

Engineering Essentials for Weldors

Most of the important engineering aspects of welding are covered in a paper prepared on this subject by H. Malcolm Priest, Engineer, Railroad Research Bureau, U. S. Steel Corporation Subsidiaries. The presentation is in form so simplified that it is readily usable by welding operators and by junior executives who have a limited background of technical training. The author explains the nature of stresses in welded structures and the importance of the different physical properties of steel in relation to those stresses. From there he proceeds to an outline of the fundamentals of design for welding for different types of loads. Without attempting to give a complete coverage of metallurgy; the paper does clarify the importance of heat conductivity and of the phenomenon of expansion and contraction in sufficient detail to indicate why welding techniques should be adjusted to take advantage of the metallurgical properties of the material wherever possible, instead of being handicapped by them. The concluding portions of the paper deal with the nature of fatigue stresses and with modern trends in the design of welded structures.

The stated objective of the paper is to establish an understanding of the principles of engineering involved in the welding of a structure between the designing engineer and the fabricator, and also to point out to the welding operator his share in the responsibility of safe and efficient welded construction. The designer will find in it numerous practical ideas, whereas the welding operator and the welding student can make good practical use of the wealth of fundamental engineering information which it contains. This paper is published by the American Welding Society, 33 W. 39th St., New York, in the form of a twenty-four page booklet available at 25c per single copy, with discounts for quantities.

» «

Resistance Welder Bulletin

Progressive Welder Co. of Detroit, has issued a **Bulletin, No. 501,** descriptive of the design and operating features of the company's now current Standard Pedestal Welder. In addition to describing the operation and design of the welder, the four page folder also embodies a number of illustrations showing how, through the application of special fixtures, etc., specialized spot welding operations may be performed on this standard pedestal welder. Copies of the bulletin may be obtained directly from the Progressive Welder Co. or from this publication.

» «

Safety Equipment Catalog

The **Sellstrom Mfg. Co.**, 615 N. Aberdeen St., Chicago, have issued a new **Catalog No. 20** illustrating the Sellstrom line of eye shields and face protectors. In this 32 page, profusely illustrated catalog, will be found the complete Sellstrom line of welding and other safety equipment. Featured are many new products. Included in the new products are several different styles of industrial spectacles and goggles as well as welding inspector's hand shields.

One of the outstanding features of this catalog is an index which makes it very easy to locate any type of eye or face safety guard you may desire.

» «

Aircraft Welding Data

As a means of reviewing the several oxy-acetylene flame and electric arc processes which are particularly helpful in accelerating the tempo of aviation production, Air Reduction, New York, has prepared a helpful 16-page booklet "Airco in Aviation."

Oxy-acetylene cutting, a fast and accurate means of shaping steel, is discussed in the light of its ability to speed up and simplify production procedures. Reference is also made to

(Continued on page 72)

Does PRODUCTION like this interest you?

101 EASY-FLO JOINTS PER HOUR!

That's the production one large washing machine manufacturer is getting by taking full advantage of Easy-Flo brazing alloy's **fast brazing action** and a rapid method of heating.

THE JOB . . .

A hex collar of cold drawn steel had to be joined to a steel tube, in the position shown at the right, to form a wringer post. The part is new, but after extensive experimenting Easy-Flo brazing was adopted as the best method of doing the job.

HERE'S HOW IT IS DONE

The operator, after cleaning surfaces to be joined, places the collar on the tube in its approximate position. He then slides a ring of Easy-Flo wire next to the collar and brushes on Handy Flux. Next he puts the assembled parts into an induction heating coil equipped with a fixture so designed that when the assembly is pushed down to the bottom, the collar is accurately positioned. While one assembly is heating, the operator prepares another, resulting in a steady flow of finished parts. Time per assembly is a little over ½ a minute—**101 joints per hour.**

FIND OUT WHAT EASY-FLO WILL DO FOR YOU

Easy-Flo joins ferrous, non-ferrous and dissimilar metals. Its brazing action is **fast** and the joints it makes **strong** and **reliable.** It can be used for a multitude of purposes. If you have a metal joining problem, **try it**—we'll be glad to cooperate. Send us full details and get our recommendations—or ask for a field engineer to call and give full details and a demonstration. Write for our new Bulletin No. 12 giving full details.

STEEL SALES CORPORATION

WAREHOUSES
Chicago, Ill., 3348 S. Pulaski Rd., Phone Crawford 4400
Detroit, Mich., 5151 Wesson Ave., Phone Tyler 6-3000
St. Louis, Mo., 4565 McRee Ave., Phone Grand 5255

DISTRICT OFFICES
3348 S. Pulaski Road Chicago, Illinois Milwaukee Minneapolis

HELP YOURSELF!

The fellows with the most stuff usually end up doing the most important work. One easy way to keep up with what's latest is by reading about it every month in THE WELDING ENGINEER. It's worth every bit of only $3.00 a year to be sure you'll not miss an issue.

If you read someone else's WELDING ENGINEER why not get your own copy. Begin with the next issue.

THE WELDING ENGINEER
506 S. Wabash Ave. Chicago, Ill.

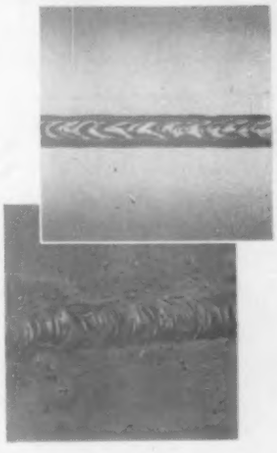
NEW! MAKES STRONGER WELDS ENDS WELD SPATTER

★

Protect-O-Metal No. 2

★

Saves Time, Labor and Welding Rod



(Upper) Welded with Protect-O-Metal
(Lower) Without Protect-O-Metal

- Protects surfaces from spatter . . . completely eliminating spatter-cleaning.
- Prevents pitting on stainless steel and galvanized material.
- Use on single or multi-pass welds . . . any amperage.
- Stabilizes and quiets arc. Reduces spatter from rod by 25% . . . saving 5% of rod.
- Eliminates all porosity.
- Increases tensile strength (over 2,000 p.s.i. on 3/16" plate) . . . by removing impurities from weld.
- Causes no smoke or odor.

Something entirely new in spatter-proofing. All statements proved in State University and commercial laboratory tests. Available now to entire arc welding industry after full year job testing in over 100 war plants. EASY TO USE . . . Just brush Protect-O-Metal No. 2 compound down seam and on surrounding surfaces where spatter usually collects. After welding, merely wipe surfaces with damp cloth. Gives perfectly clean job—without grinding, scraping or washing. Provides clean surface for paint finish. Test it yourself.

★ **Write or wire for FREE SAMPLE**

G. W. SMITH & SONS, 79 So. Sperling Ave., Dayton, Ohio

Current Reviews

(Continued from page 70)

production welding, the welding of jigs and fixtures, flame hardening, low temperature brazing, flame cleaning and various other metal working techniques.

The last section of "Airco in Aviation" describes the engineering assistance which the manufacturer offers the aviation industry to assure best results from its use of the company's products and processes. Copies of "Airco in Aviation" can be obtained by writing to the Advertising Dept., Air Reduction, 60 E. 42nd St., New York.

» «

Electrode Bulletin

"Eureka Alloy Electrodes" is the title of a new 4 page bulletin recently issued by **Welding Equipment & Supply Co.**, Detroit. In this bulletin there is described the various alloy electrodes manufactured by this organization for the welding of heat resisting materials, cast iron, bronze, copper, stainless steel and SAE specifications as well as special alloy electrodes manufactured by this company.

» «

Induction Heating

The **Induction Heating Corp.**, 389 Lafayette St., New York, announce the inauguration of a series of data sheets covering completely the subject of induction heating. These sheets, which will be issued monthly, will be furnished to interested parties upon application. **Data Sheet No. 1** deals with the elemental theory of induction heating and discusses current frequencies, magnetic fields and heat producing losses.

» «

Brazing Bulletin

In a two page bulletin recently released by **Handy & Harman** there is described and pictured the many ways in which silver solders may be used advantageously in tool repair and brazing. This bulletin, known as **Low Temperature Brazing News**, may be obtained from Handy & Harman, 82 Fulton St., New York, N .Y.

» «

Electrical Catalog

A 64-page 1942 revision of the **"Quick Selector Catalog"** is announced by the Westinghouse Elec. and Mfg. Co. Issued twice a year, this catalog has become extremely popular, as it simplifies the selection of many types of electrical equipment.

A number of additions and changes have been made in the April 1942 edition which make the catalog more useful than ever before. The general subjects covered include; safety switches, no-fuze breakers, multi-breakers, panelboards, motor control and motors. New application data, on latest equipment in each of these groups, has been included.

Despite revisions, the general format of the catalog has been retained. Electrical ratings, physical dimensions, and circuit diagrams expedite the selection of correct equipment for each purpose. A copy of the April 1942 "Quick Selector" Catalog 30-000 may be secured from department 7-N-20, **Westinghouse Elec. and Mfg. Co.**, E. Pittsburgh, Pa.

» «

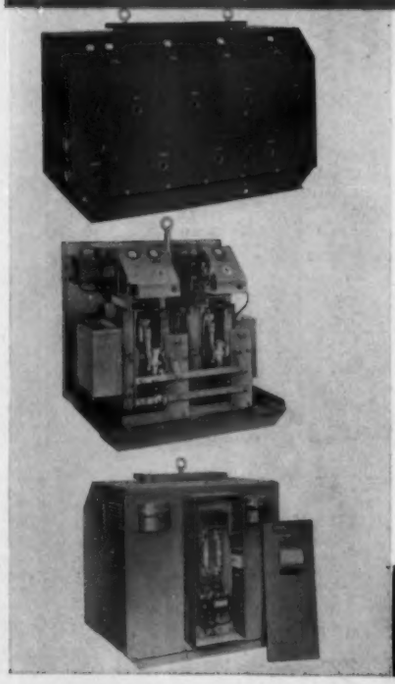
Auto-Starters Leaflet

Manual auto-starters are described in a new four-page leaflet announced by Westinghouse Electric and Mfg. Co.

Two-step operation with protection against low voltage overload and incorrect sequence is discussed. Interlocked starting sequence and automatic return to "off" position are described with a note on rolling contacts and bimetal relays. Gasketed enclosures, methods of arc extinction, and accessories are included. The leaflet is well-illustrated with wiring diagrams and closeup views of principal parts. A tabulation lists recommended starter sizes for common horsepower and volt-

(Continued on page 74)

CUT INSTALLATION TIME & COST



with G-R SELF-CONTAINED MULTI-PURPOSE WELDERS *for*

- MANUAL . . .
- AUTOMATIC . . .
- UNIONMELT WELDING

• G-R Model 85, 2000-amp. Handles up to 4 hand lines.

• Model 65, case removed to show built-in power factor correctors, etc.

• Model 65, rear view, showing primary contactor and quick change-over switches for automatic-hand.multiline operation.

G-R welders from 300 to 2000 ampere capacity are available with built-in contactors, remote control facilities and power factor correctors. They even include a 3 KVA 440/110 v. transformer to provide power for thyrotron controls, vacuum cleaners, etc. Installation is simple, fast and economical. High efficiency (85-95%) means greater output without increasing your plant load . . . if you want to step up production, get the facts NOW about G-R units — just write or wire:

GLENN-ROBERTS COMPANY
1009 FRUITVALE AVENUE, OAKLAND, CALIF.
CHICAGO: 5651 W. OHIO STREET

The Improved "Round File" Gas Lighter

Most Economical

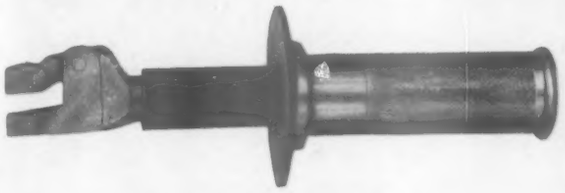
Unrivalled economy is provided by the many superior, exclusive design and construction features of the Improved "Round File" lighter.

A large file area is provided — approximately one square inch. The file is of superior quality, hardened in our own factory. The spark metal is of large diameter and the patented cartridge holding the metal locks exactly into position, permitting instant replacement. Every part of the lighter is thoroughly tested.

Circular and prices on request

SAFETY GAS LIGHTER CO. (Est. 1901) LYNN, MASS.

THE VISE GRIP HOLDER



HOL-TITE
(Trade Mark Reg.)

HOL-TITE Holders are winning their way in the welding industry because they fill a need for positive electrode contacts.

This results in
LOW MAINTENANCE COSTS
the reason why they do their job so well.

It's so easy to replace these 2 parts making the holder again as good as new.

Try a HOL-TITE HOLDER for comparison—a surprise awaits you.

HOL-TITE
HOLDER COMPANY
(Formerly Henne Mfg. Co.)
HERRIN, ILLINOIS

INSURE YOUR ACETYLENE SUPPLY WITH SIGHT FEED!

Take the matter into your own hands. Make certain that you will *always* have acetylene on hand when and as you need it.

You can do this by getting a SIGHT FEED Portable Acetylene Generator NOW!

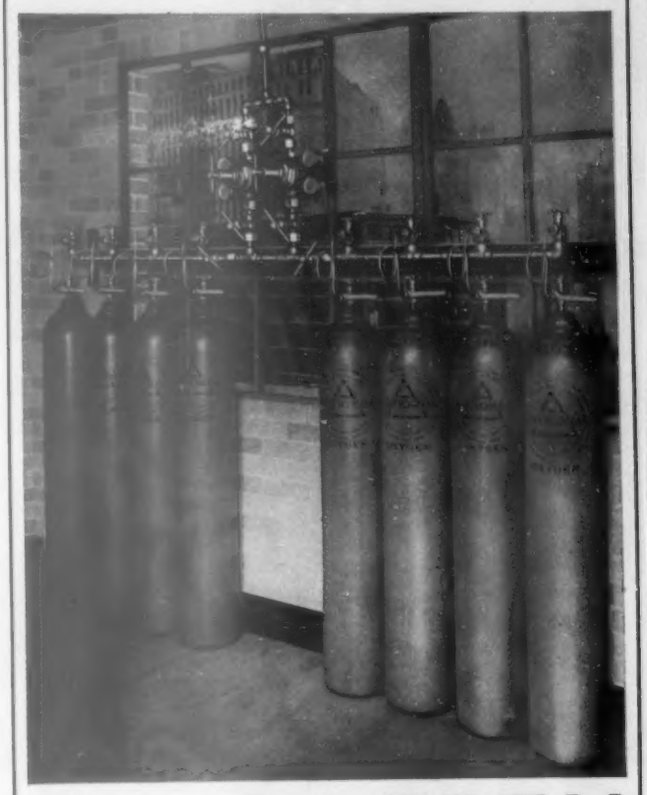
And at the same time you *will* save 50% to 75% of your present acetylene costs.

In addition to convenience and money saving features, SIGHT FEED offers you a visible supply of carbide at all times and real portability.

A range of 9 sizes in Generators and two models in 6 sizes in trucks assures you of the right size for your use.

Play safe! Write for a catalog today—sure.

The Sight Feed Generator Co.
Tenth St. Richmond, Indiana



For SAFETY *SPEED* ECONOMY

MANIFOLDS
REGULATORS
VALVES and FITTINGS

to control high pressure gases

The BASTIAN-BLESSING Co.
4239 W. PETERSON AVE. CHICAGO
Pioneers and Manufacturers of Precision Equipment for Using and Controlling High Pressure Gases

TEST IT

BINGROD

IT'S TOUGH

For That Tough Hard-facing Job

Here's a hard-facing rod that's "got what it takes." It is easy to put on . . . Parent metal needs no cleaning . . . Just flow it over a rusty surface —and IT FUSES!

The *Speed, Economy* and *Durability* of Bingrod were never more needed than now. Try Bingrod today!

HELP THE FARMERS! — and Help Yourself

This year farmers are going to plant, grow and harvest all their soil will bear. But they'll have to rely on what machinery they have. You can help them make it last longer and work harder by hardfacing—with BINGROD. Its toughness will prove to more farmers the value of hardfacing to make equipment last longer.

Write today for BINGROD descriptive folder

THE BINGROD COMPANY

460 W. MICHIGAN AVE.
KALAMAZOO, MICH.

ADJUSTABLE FROM THE SIDE AT THIS POINT → WHILE ON THE HEAD!

THE NEW CESCO
No. 406
HELMET

The Only Helmet Adjustable from the Side While On the Head! Has a soft, sponge rubber cushioned headband with adjustable chin rest. 3 models.

No. 406 Helmet has standard glass holder without lift-front feature.

No. 407 Handshield with standard glass holder.

No. 409 Helmet with lift-front glass holder.

CHICAGO EYE SHIELD CO., 2303 Warren Boulevard CHICAGO, ILLINOIS

KEEP 'EM WRITING

To get the *best* from your typewriters call a Royal-trained, Royal-approved service man. Prompt, expert, trouble-free repairs assured. Use Roytype Typewriter Supplies — Ribbons and Carbons—made by Royal.

Royal Typewriter Co., Inc.
427 W. Randolph St., Chicago
Phone Randolph 0200

Current Reviews

(Concluded from page 72)

age ratings of motors used on 25, 40, 50, and 60-cycle circuits.

A copy of **Descriptive Data 10-700** may be secured from department 7-N-20, Westinghouse Electric and Mfg. Co., E. Pittsburgh, Pa.

Recent Patents

Cylinder Welding

2,276,106. **Watson Sidney,** Summit, N. J., assigned to **Radio Corp. of America.** Filed June 27, 1940. Issued Mar. 10, 1942. The method of making a cylinder from a strip of sheet metal with edge portions of the strip longitudinally of the cylinder welded together, comprising wrapping a piece of sheet metal around a mandrel and forming the sheet to the contour of the mandrel, and forming the edge portions of the sheet into side-by-side upstanding flanges longitudinally of the mandrel. The pressure between the mandrel and cylinder is then released, and welding current is passed transversely through the contacting flanges while the flanges are pressed together.

» «

Gas Welding

2,276,190. **Anders R. Gunnert,** Lidingo, Sweden, assigned to **Svenska Aktiebolaget,** Stockholm, Sweden. Filed July 6, 1939. Issued Mar. 10, 1942. The patent describes a method of joining metal members having opposed edges, by means of butt welding with a gas flame and filler rod. The method comprises maintaining the flow of gas delivered to the flame at a pressure to provide the flame with an inner elongated cone into which the gas issues at a velocity within a range of which the lower limit is of the orders of 130 meters per second. The edge surfaces are spaced apart at a distance substantially equal to the width of the cone to form a welding channel between the edge surfaces. The tip of the cone is maintained just in front of the filler rod and at a level at least substantially one-third of the depth of the channel; and the cone is maintained substantially normal to the longitudinal path of the channel and to the work surfaces. Concurrently the cone and the rod are advanced along the channel.

» «

Weld Flux

2,274,637. **Robert M. Rooke,** Jersey City, N. J., and **Frederick C. Saacke,** Astoria, Long Island, N. Y., assigned to **Air Reduction Co., Inc.,** New York. Filed Mar. 5, 1940. Issued Mar. 3, 1942. Ordinary brass, or so-called bronze, welding rods are stated by the patent to give off troublesome zinc fumes when melted by welding flames, and the resulting weld metal is more or less porous and lacking in strength by reason of porosity. The object of this invention is to provide a flux, and a copper-zinc alloy welding rod having associated flux, in the use of which zinc fuming is markedly reduced or suppressed. Oxidation of constituents other than zinc, for example manganese and tin, the oxides of which would weaken the weld deposit, is prevented or materially lessened. The puddle of molten metal is protected against the absorption of gases, and the bond between the weld metal and the base metal are greatly improved. The new flux may contain, for example, boric acid, 32.5%; borax 6.0%; water glass, 40° Be', 5.0%, potassium dichromate, 1.0%; and water 55.5%. The flux is applicable to all brass or bronze welding rods. A borax to boric acid ratio of 1 to 5 is advantageous in the flux. Suitable binders may also be employed, such as collodion, latex, and waxes, such as carnauba and beeswax. Deposition of a nitrocellulose skin on the flux coating affords excellent protection and permits the coated rod to be bent and handled freely.

» «

Large Plate Assembly

2,274,742. **Bela Ronay,** Annapolis, Md. Filed May 10, 1941. Issued Mar. 3, 1942. The apparatus of this patent is designed to weld relatively long seams

(Continued on page 76)

Got Troubles?

Got "bugs" in your gas welding of Nickel Chrome Alloys? If so, Fluxine No. 18 is your answer. It positively meets U. S. Air Corps "specs" covering flux for gas welding Nickel Chrome Alloys, Monel, Stainless Steel, Inconel, and Nickel. Gives off minimum fumes. Induces quick flow of rod and deep penetration. Produces strong, porosity-free joints. KREMBS AND COMPANY, 671 W. Ohio St., Chicago, Ill. Chemists and Metallurgists Since 1875.

FLUXINE

TRADE MARK REGISTERED U.S. PATENT OFFICE

UNTIE YOUR HANDS!

With This

3-in-1 TOOL

For Cleaning and Brushing

SLAG — SPATTER — WELDS

You don't have to set aside your rod holder every time it is necessary to chip with a cold chisel and hammer. With the combination drift-chisel and brush feature of this hammer, one hand is always free for manipulation. C.M. & D. hammers are ideal for chipping and brushing in close quarters.

ASK YOUR JOBBER ABOUT THEM
or write us direct

CHICAGO MFG. & DISTRIBUTING CO.
1928 W. 46TH ST.
CHICAGO, ILLINOIS

TO MEET SPECIFIC
WELDING REQUIREMENTS

Use PERFECTION
WELDING ELECTRODES

PERFECTION P-60
For Single Pass Fillet Welds . . .

Here is a coated electrode designed especially for single or multiple pass welding of all types of mild steel sections where the fit-up is bad —for single pass fillet welds in marine and tank construction, structural assemblies and machine bases.

"Perfection" arc welding electrodes are manufactured to strictest specifications with the same care of making the finest quality "Perfection" rivets for 30 years—used throughout the United States in all classes of steel fabrication.

Write for our catalog describing uses and characteristics of various Perfection electrodes for use on Mild Steels, Cast Iron, Carbon Moly and Low Alloy High Tensile Steels.

THE ANTHONY CARLIN CO.
2717 East 75th St. CLEVELAND, OHIO

National
Carbide

•

EFFICIENT

ECONOMICAL

DEPENDABLE

•

For
Welding and Cutting

Specify

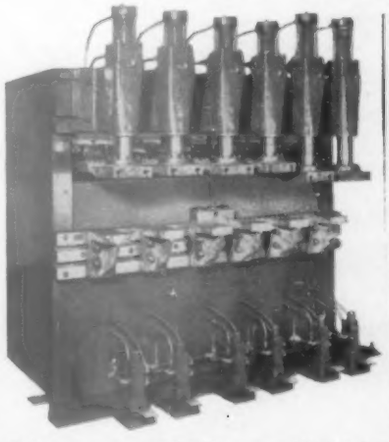
NATIONAL CARBIDE IN THE RED DRUM

•

NATIONAL CARBIDE CORPORATION
60 E. 42nd St., New York, N. Y.

SPEED-UP
For Defense and Victory With *ACRO* Welders

Shell Cases are Welded Continuously, Accurately and Fast on this specially designed Acro Projection Welder.



When it comes to making shell cases on a real production basis this hydraulically operated Acro Projection Welder fills the bill. It has six independent work stations, each controlled by an individual operating valve and actuated by a hydraulically-operated system through double acting cylinders. Capacity of the transformer is 350 K.v.a. Controls consist of ignitron tube contactor, pneumatic welding period timer, eight point heat regulator and other accessories to provide a complete machine.

Step up your production—consult Acro for the machine to fit your particular needs. Acro is prepared to design any type spot, seam or butt welder. The standard line of Acro Welders gives trouble-free service on all types of resistance welding. Write today for more details. There will be no obligation.

ACRO WELDER MFG. CO., Inc.
1827 West St. Paul Ave., Milwaukee, Wis.

SPEED WELDING PRODUCTION

with Steel-Grip one-piece-back welders' gloves

Specially designed Steel-Grip Welders' Gloves give extra protection against heat and wear. Keep production "rolling." Entire back cut in one piece from special tanned heat-resistant leathers. No seams in back. No burned-through or ripped seams. Wool heat breaker lining inside back for added protection. Finger seams welted at points of greatest wear. Wide strap thumb reinforcement. Try a pair. Only $1.85. Outlast other gloves. Order No. 13475 *now* from jobber or direct. 10% discount on 12 pair lots. Write for welders' clothing catalog.

INDUSTRIAL GLOVES COMPANY
201 Garfield Boulevard **Danville, Illinois**
Canada: Safety Supply Co., Toronto

CLAMPS

"JORGENSEN"
Extra Quality
Series 820 Welders Heavy Frame Deep Throat with Crank or Bar Handle with or without
Shielded Screw
A large variety of others to choose from
Send for Catalog No. 15

ADJUSTABLE CLAMP CO.
"The Clamp Folks"
426 N. Ashland Ave., Chicago, U. S. A.

Sellstrom safeguards

Make Sure . . . your Workers Are Safe in Your Production Drive

Injured workers mean idle machines—and we can't afford either these days. Protect your workers with Sellstrom Safeguards which are scientifically designed and backed by years of engineering and manufacturing experience. Why not consult one of our engineers—or write for a catalog?

Sellstrom Manufacturing Co.
626-5 N. Aberdeen St., Chicago, Ill.

CRACK DOWN ON Spatter COSTS!

SPATTER-NOX — Reduces weld spatter 50-75%; cuts cleaning time 50%; increases welding speed 30-50%. Inhibits rust and is a good foundation for paint. Simply brush or spray on. Covers 650-700 sq. ft. per gallon. Low priced—$1.75 per gallon.

SPATTER-OFF — A companion water soluble product. Used where welds are to be pickled for galvanising, sherardizing or plating. Spatter-Off is non-fuming. Covers 500 sq. ft. per gallon. Low priced—$1.00 per gallon.

Write for latest descriptive bulletin or trial sample

UNIVERSAL POWER CORPORATION
4299 Euclid Avenue **Cleveland, Ohio**

Recent Patents

(Continued from page 74)

such as are encountered in the fabrication of boiler drums and other large plate assemblies. The inventor points out that the successful deposition of a welding electrode on large curved surfaces, such as boilers, requires special training. The patented apparatus is designed to obtain uniform metal deposition without particular skill or handling. The apparatus embodies a hydraulically controlled gravity feed for the welding electrodes. The device includes a base mounted for movement along a line to be welded, and a support mounted on the base for adjustment to an angle with the horizontal. A cradle is mounted on the support for rotation about a pivot located intermediate its ends. A carriage is mounted on the cradle for movement longitudinally thereof, and an electrode holder is mounted on the carriage at each end. The carriage is movable downwardly along the cradle under the influence of gravity to feed an electrode in the lowermost holder toward the structure being welded. The rate of downward movement of the carriage is adjusted to correspond to the rate of consumption of the electrode. The cradle is rotatable about the pivot to reverse the position of the holders and move a fresh electrode in the uppermost holder into welding position when the first mentioned electrode is consumed to in turn descend toward the structure.

» «

Clad Metal

2,275,419. **Otis R. Carpenter,** Barberton, Ohio, assigned to **The Babcock & Wilcox Co.,** Newark, N. J. Filed Mar. 15, 1938. Issued Mar. 10, 1942. The method of manufacturing composite clad plate having a laminated metallic veneering of corrosion resistant metal consisting of the steps of disposing a plurality of thin sheets of corrosion resistant metal upon a thick base plate of weldable metal, the sheets being separate and unbonded to each other over at least the major parts of their areas, and then simultaneously integrating the plate and the sheets by forming successively overlapping resistance welds between the plate and its adjacent sheet and between adjacent sheets.

» «

Resistance Welding

2,276,010. **George S. Bernard, Jr.,** New Kensington, Pa., assigned to **Aluminum Co. of America,** Pittsburgh. Filed Sept. 22, 1939. Issued Mar. 10, 1942. The improvement which consists in affecting the amount of local heating at a selected bi-metal electrode-work piece juncture by the steps of selecting the electrode-work piece juncture at which local heating is to be affected in the desired way, and of at least initially controlling the welding current so that the flow of the current at that juncture is in a direction selected to produce the desired effect, whereby at least the initial current flow may be directed to minimize or maximize the total local heating developed at the juncture.

» «

Welding Circuit

2,276,060. **Frederick C. Owen,** Fayetteville, N. C. Filed Dec. 14, 1939. Issued Mar. 10, 1942. The apparatus of this patent is one in which the capacity for power factor correction is independent of that used for the production of oscillating currents. The apparatus makes it possible for the operator by quick adjustment, to secure the arc best suited for the particular work in hand. There is included a power transformer, an oscillating transformer, and a reactor comprising a group of windings. The secondaries of the transformers are wound in groups. The reactor and the transformer secondaries are serially connected to constitute a welding circuit in which the work and electrode are serially included. The group members of the secondaries intervene electrically between the group members of the reactor. The group members can be actively varied in the circuit.

» «

Welding Equipment

2,270,767. **Henry T. Platz,** Detroit, Mich., assigned to **Briggs Mfg. Co.,** Detroit. Filed Jan. 29, 1940. Issued Jan. 20, 1942. In an electric welding apparatus, a pair of relatively movable electrodes, which cooperate with each other to clamp the work to be welded therebetween, and arranged in an electric circuit controlled by a switch. Fluid pressure actuated elements are used for relatively moving the electrodes into engagement with the work. The pressure can be controlled and the control is operable upon engagement of the electrodes with the work to increase the pressure to a predetermined maximum value. The fluid pressure controls the operation of the circuit switch to successively close and open the circuit to the electrodes during the rise in pressure to the maximum value.

» «

Coated Weldrod

2,271,358. **Gilbert Wilkes, Louden E. MacFadyen, Dale S. Rice,** and **George L. Alpaugh,** High Bridge, N. J., assigned to **Taylor-Wharton Iron and Steel Co.,** High Bridge, N. J. Filed Aug. 23, 1940. Issued Jan. 27, 1942. This patent describes an improved weldrod having a dipped coating comparable to extruded coatings and resulting from a mixture of flux and slag-producing materials together with an effective amount of potassium permanganate. The purpose and result of this composition is to promote crystal growth manifested as a close interwoven system of hair-like fibrous form which extends throughout the mass and fills voids and makes for density, hardness and uniformity. The coating is comparable to extruded coatings in its freedom from flaking and general behaviour under the action of the arc.

(Continued on page 78)

GREYHOUND

CUSTOM-BUILT A.C. ARC WELDERS

6 Models—Ranging from 100 to 500 Amps.
Priced from $69.00 to $395.00
— FEATURING —
Five Year Guarantee
G.E. Double-woven Spun Glass Magnet Wire
Asbestos and Mica Insulation
Scientifically Cooled
Continuous Operation
Lowest Operating Cost
Convenient terms; monthly payments
Jobbers inquiries solicited.

INDUSTRIAL MODEL S.P. 500

Greyhound Electric Mfg. Co., Inc.
31 Grand Street, Brooklyn, New York

Spe-Weld

Welding and Brazing Rods and Fluxes for All Metals at Low Temperatures

Stainless Steel Electrodes
Machineable Cast Iron Electrodes

SPECIAL WELDING ALLOY CO., Inc.
27-26 Jackson Ave., Long Island City, N. Y.

Ask the Man who Knows
MINNEAPOLIS

He'll tell you The Andrews is an outstanding hotel. Located in the center of downtown district, close to shops and amusements ... you'll enjoy comfortable, attractively furnished guest rooms, fine food in the Coffee Shop and superior service. Garage. All rates are reasonable.

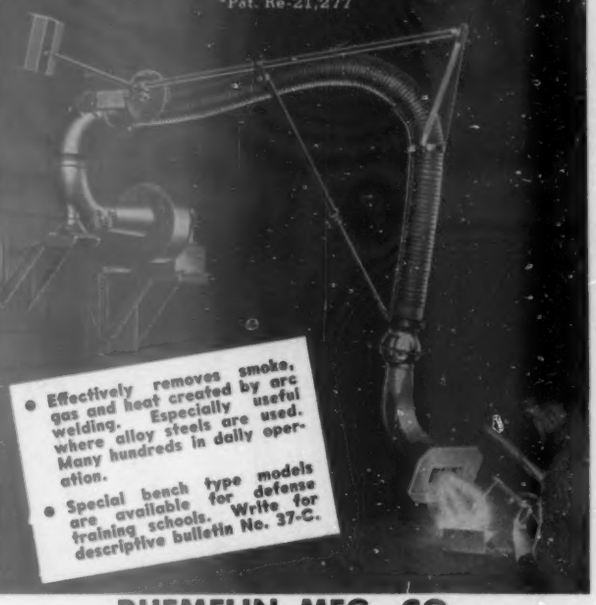
ARTHUR W. STADE
Manager

THE *Andrews* HOTEL
4th STREET AT HENNEPIN

Banish Welding Fumes!

Here's a Practical Welding Fume Collector that Removes Noxious Gases, Heat and Smoke at the Source

*Pat. Re-21,277



- Effectively removes smoke, gas and heat created by arc welding. Especially useful where alloy steels are used. Many hundreds in daily operation.
- Special bench type models are available for defense training schools. Write for descriptive bulletin No. 37-C.

RUEMELIN MFG. CO.
3880 N. Palmer St. Milwaukee, Wis.

RUEMELIN FUME COLLECTOR

Fluxes cost SO LITTLE yet are SO IMPORTANT

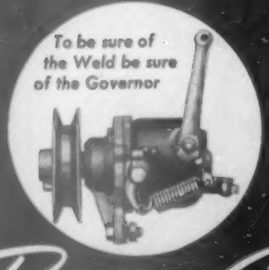
Use only those GOOD Guaranteed

"ANTI-BORAX" FLUXES

No. 1 Cast Iron Welding Flux.
No. 2 Brazing Flux for Brass, Bronze, etc.
No. 4 "Braz-Cast" Flux for Bronze Welding Cast Iron.
No. 5 Aluminum Flux for Cast Aluminum.
No. 8 Aluminum Flux for Sheet Aluminum.
No. 9 Stainless Steel Welding Flux.
No. 10 Silver Solder Flux.
No. 11 Tinning Compound for Fender Work.

MANUFACTURED ONLY BY

ANTI-BORAX COMPOUND CO., Fort Wayne, Ind.



Standard Equipment on Leading Welders!

Pierce Governors

THE PIERCE GOVERNOR COMPANY
1607 OHIO AVENUE • ANDERSON, INDIANA

YOU CAN PROFITABLY

REMEMBER!

It's an easy rule to remember when you come to Cleveland. Head right for friendly Hotel Carter and you're sure to enjoy your stay in this friendly city.

600 outside rooms. All with bath and circulating ice water 3 air-conditioned restaurants.

Single from $3.00
Double from $4.50

HOTEL CARTER

Prospect near Ninth
Cleveland

ALLEN JAMES LOWE, Man. Dir

Affiliated with
American Hotels Corp. of N. Y.
J. LESLIE KINCAID, President

Recent Patents

(Concluded from page 76)

Weldrod Adjustment

2,271,723. **James E. Trainer,** Fairlawn, Ohio, assigned to **The Babcock & Wilcox Co.,** Newark, N. J. Filed Oct. 25, 1938. Issued Feb. 3, 1942. There is shown a welding machine which has a welding head having weldrod guiding and feeding elements, and a unit for angularly adjusting the weldrod about axes intersecting substantially in the line of weldrod travel.

» «

Welding Head

2,272,158. **Jasper E. Anderson,** Saugus, Mass., assigned to **General Electric Co.,** Schnectady, N. Y. Filed Nov. 28, 1940. Issued Feb. 3, 1942. An arc welding head comprising a pair of shafts spaced from one another by a fixed distance, one of the shafts being rotatable. An expansible feed roll forms one of a pair of feed rolls mounted opposite one another on the shafts. The expansible roll diameter can be adjustably varied to control its driving engagement with electrodes of different sizes positioned between the feed rolls.

» «

Carbon Holder

2,274,157. **Clayton P. Nielsen,** Chicago. Filed Dec. 4, 1939. Issued Feb. 24, 1942. This invention has to do with a holder for the electrodes of an electrical arc welder. It is an object of the patent to provide a device which uses an arc between two electrodes, preferably carbon, which arc may be controlled at least to some degree, providing a hot arc or one not so hot; the use of any gas causing a "blow" being eliminated; the position of the carbons being adjustable to compensate for deterioration of the electrodes to control the intensity of the arc flame. The position of one carbon is spaced from the position of the other carbon in a direction longitudinally of the carbon holder. This provides for the flame to be at all times clearly visible. The holder also can be manipulated by a single hand. The holder has two tips carried by a conducting tubular member and a longitudinally movable conducting member. A thumb bolt or the like cooperates with an automatic catch to maintain the electrodes in normal operating position. A spring on the thumb bolt is operable to move the electrode apart breaking the arc upon release of the catch.

» «

Multiple Spot Welding

2,274,169. **Robert Schiff,** Detroit, assigned to **General Motors Corp.,** Detroit, Mich. Filed Jan. 22, 1940. Issued Feb. 24, 1942. An improved electrical energy system for spot welders, which includes the combination of a plurality of load devices and a transformer serving the devices having a primary circuit and having a secondary divided into fractional turns and a set of companion devices connected to the adjoining ends of the fractional turns at each split.

» «

Welding Torch

2,274,631. **Russell Meredith,** Los Angeles, assigned to **Northrop Aircraft, Inc.,** Hawthorne, Cal. Filed Jan. 4, 1941. Issued Feb. 24, 1942. This patent relates to an open arc welding torch consisting of a hollow handle, and a hollow nozzle angularly attached to the handle with the interior of the nozzle connected with the interior of the handle. One end of the nozzle is open and a conducting fitting insulated from the nozzle is attached to the other end and closes that end. A refractory welding electrode is slidable in this fitting and is retained by the fitting in axial relation to the interior wall of the nozzle with an annular space separating the electrodes from the inner nozzle wall. The fitting is connected to an electrical conductor. The handle of the torch has connected thereto a source of inert gas. The nozzle wall is shaped so as to flare gradually outward as the open end is approached, and then to curve back to terminate at the opening. This provides an enlarged portion of the annular space adjacent to the opening.

NEMCO WELD FILLER

Makes Cast Iron Electric Welds Water Tight
SAMPLE ON REQUEST
TESTED TO 70 LBS. PER SQUARE INCH
Attractive Proposition to Distributors
NORTHEAST METALS CO.
4124 TORRESDALE AVENUE
PHILADELPHIA PENNA.

LEARN ABOUT THE NEW PROCESS OF **LOW TEMPERATURE WELDING**
Standardized by leading manufacturers for:
Salvaging of Defective Castings in cast iron, malleable steel, bronze, brass, nickel, aluminum, etc. Faster Production of fabricated parts in steel, stainless, chrome-moly, nonferrous, aluminum and for salvaging tools.
with CASTOLIN EUTECTIC WELDING ALLOYS
FREE LITERATURE
Write on your firm letterhead for new 32-page book on Low Temperature Welding.
Manufactured by
EUTECTIC WELDING ALLOYS, Inc.
40 Worth St.,—New York, N.Y.